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Bull Creek
Watershed Analysis

Ecosystem Analysis at the Watershed Scale

Bend/Ft. Rock Ranger District, Deschutes National Forest

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BULL CREEK SUBWATERSHED ANALYSIS UPDATE

INTRODUCTION

Watershed analyses are intended to develop a scientifically based understanding of the interaction of process and landscape patterns within the watershed to serve as a guide for the type and priority of future restoration and management activities. It also is to be used as a tool for subsequent management decisions that rely upon a greater understanding of existing and continuing conditions which may or may not be the result of human interaction with the ecosystem. This planning document will be used to determine strategies for sustaining the assessment area for the future. NEPA review or regulatory prescriptions are not required.

The Federal Guide for Watershed Analysis (Guide) states: "Federal Agencies will conduct multiple analysis iterations of watersheds as new information becomes available or as ecological conditions, management needs, or social issues change." The need for an update may be triggered by major changes in watershed condition or if existing analysis do not adequately support informed decision making for particular projects or issues. As analysis updates are conducted, new information is to be added to existing analyses.

The Guide outlines a six-step process for conducting a watershed analysis. The six steps in the process are listed below. In this report the six steps are separated into different chapters. Chapters begin with a short introduction explaining the purpose of each step in the process.

Table 1: Comparison of the Six Step Process and the Deep Canyon Watershed Analysis Report

Six Step Process from the Watershed Analysis Guide	Deep Creek Watershed Analysis Report
1) Characterize the Watershed	Chapter 1. Watershed Characterization
2) Identify Issues & Key Questions	Issues included in Chapter 1. Issue Identification, or Key Questions included in Appendix A.
3) Describe Current Conditions	Chapter 2, Findings and Synthesis of Information.
4) Describe Reference Conditions	Chapter 2, Findings and Synthesis of Information.
5) Synthesize and Interpret Results	Chapter 2, Findings and Synthesis of Information.
6) Develop Recommendations	Chapter 4. Recommendations

The purpose of step 1 is to identify the dominant physical, biological and human processes or features of the watershed (in this case, the assessment area) that affect ecosystem functions or conditions. When characterizing the assessment area, the team identified the most important land allocations, plan objectives, and regulatory constraints that influence resource management in the area. The watershed context is used to identify the primary ecosystem elements needing more detailed analysis in subsequent steps.

CRITERIA FOR WATERSHED ANALYSIS UPDATES AND REVISIONS

Watershed Analyses are ongoing, iterative, evolving processes. This is a dynamic document and will be revised and updated, as appropriate, as new information becomes available for the Analysis Area. Updates for this document may include the following types of information: resource data collected at the project level, monitoring data and analysis results, and questions and answers pertaining to clarification of findings and recommendations contained in this report. Revisions of this document are warranted when new data and information indicates important changes in watershed conditions and trends.

This document is intended to update changes in conditions within the analyzed watershed that have occurred since the completion of the previous analysis. It **is not** intended to replace earlier documents which should continue to be reviewed for planning purposes.

This Bull Creek Watershed Analysis is a partial update of the 1998 Bend Watershed Analysis. This analysis focuses on the Bull Creek subwatershed (Hydrologic Unit Code 170703010603). Bull Creek is part of the larger Deep Canyon watershed (Hydrologic Unit code 1707030106). The Deep Canyon watershed contains the Three Creek, Snow Creek Ditch, Deep Canyon Dam/Deep Canyon, and Bull Creek subwatersheds. Previous landscape assessments that include portions of the Deep Canyon Watershed (Figure 2, page 10) are:

- Sisters/Whychus Watershed Analysis, 1998
- Whychus Watershed Analysis Update, 2009 (Squaw Creek watershed and all of the Deep Canyon watershed with the exception of the majority of the Bull Creek subwatershed)
- Bend Watershed Analysis, 1998
- Tumalo Creek Watershed Analysis Update, 2007 (parts of the Bull Creek and Snow Creek subwatersheds and Tumalo watershed).
- Bearwallow-Triangle Landscape Assessment, 2008 (parts of the Deep Canyon and Tumalo watersheds)

A programmatic assessment that was based on the National Watershed Condition Framework (WCF) was completed by the Deschutes National Forest in 2011. It generated values relative to a condition rating for all 10th field watersheds on the Deschutes and Ochoco National Forests. All other Forests nationwide have completed similar assessments based on the WCF. Condition ratings, based on classification of watershed conditions, will be used for future planning and funding prioritization.

PURPOSE AND SCOPE

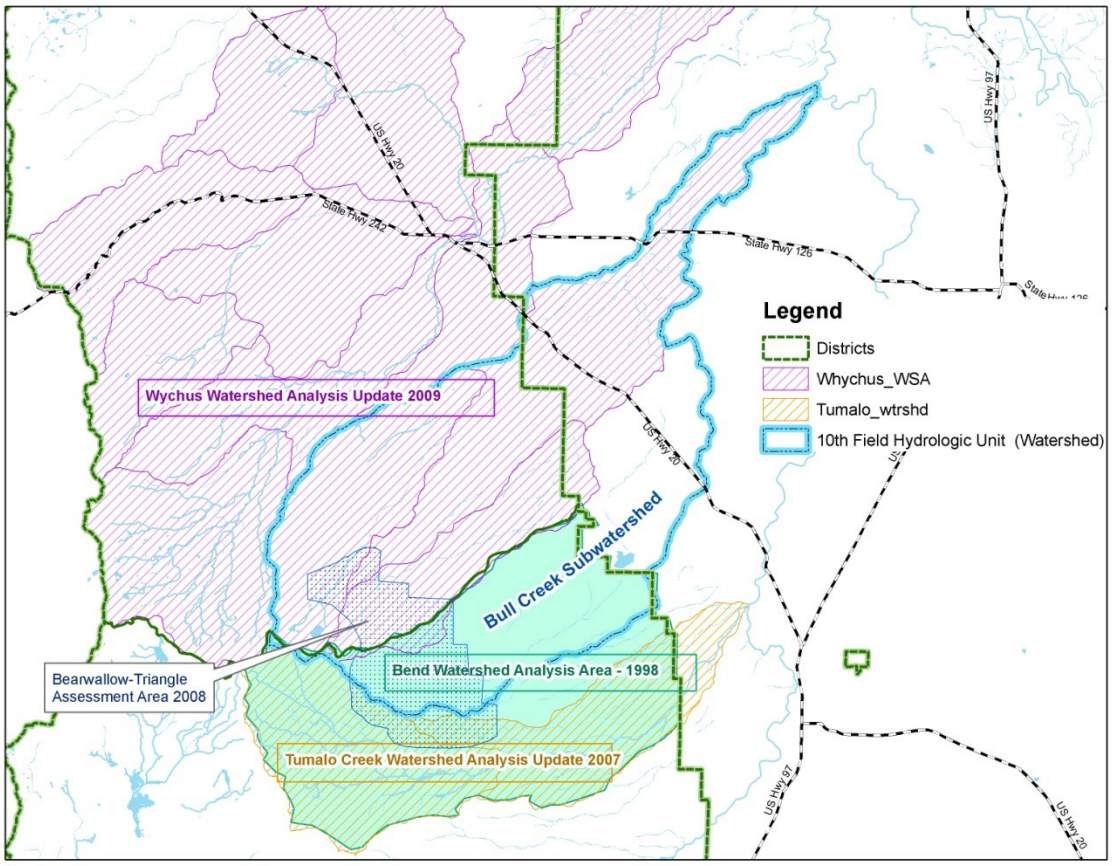
- Updates a portion of the 1998 Bend Watershed Analysis
- Analyzes effects of changes in the watershed since 1998
- Identifies trends of concern
- Prioritizes areas to guide future management
- Provides recommendations
- Identifies data gaps and monitoring needs

MAJOR CHANGES SINCE 1998

- **Lodgepole Pine Mortality in High Elevation Forest:** A high incidence of mortality (approximately 90%) of lodgepole pine has occurred, largely due to insects. There is much standing dead trees. It is estimated that within approximately 7 years dead down trees will provide heavy fuel loads.
- **Population increases in Bend and Deschutes County:** Deschutes County has recently been one of the fastest growing areas in Oregon. Adjacent to the watershed are private lands that have either been developed or have potential development opportunities. The Fidelity tree farm has been proposed for development if it is not purchased by the Deschutes Land Trust.
- **Evolving social and management issues-** These include: increased use by off road vehicles and mountain bike trail development, particularly in the lower elevation ponderosa pine forest and in areas of private lands.

CHAPTER 1: WATERSHED CHARACTERIZATION

Figure 1: Bull Creek Subwatershed and Previous Assessments Covering Deep Canyon Watershed



WATERSHED OVERVIEW

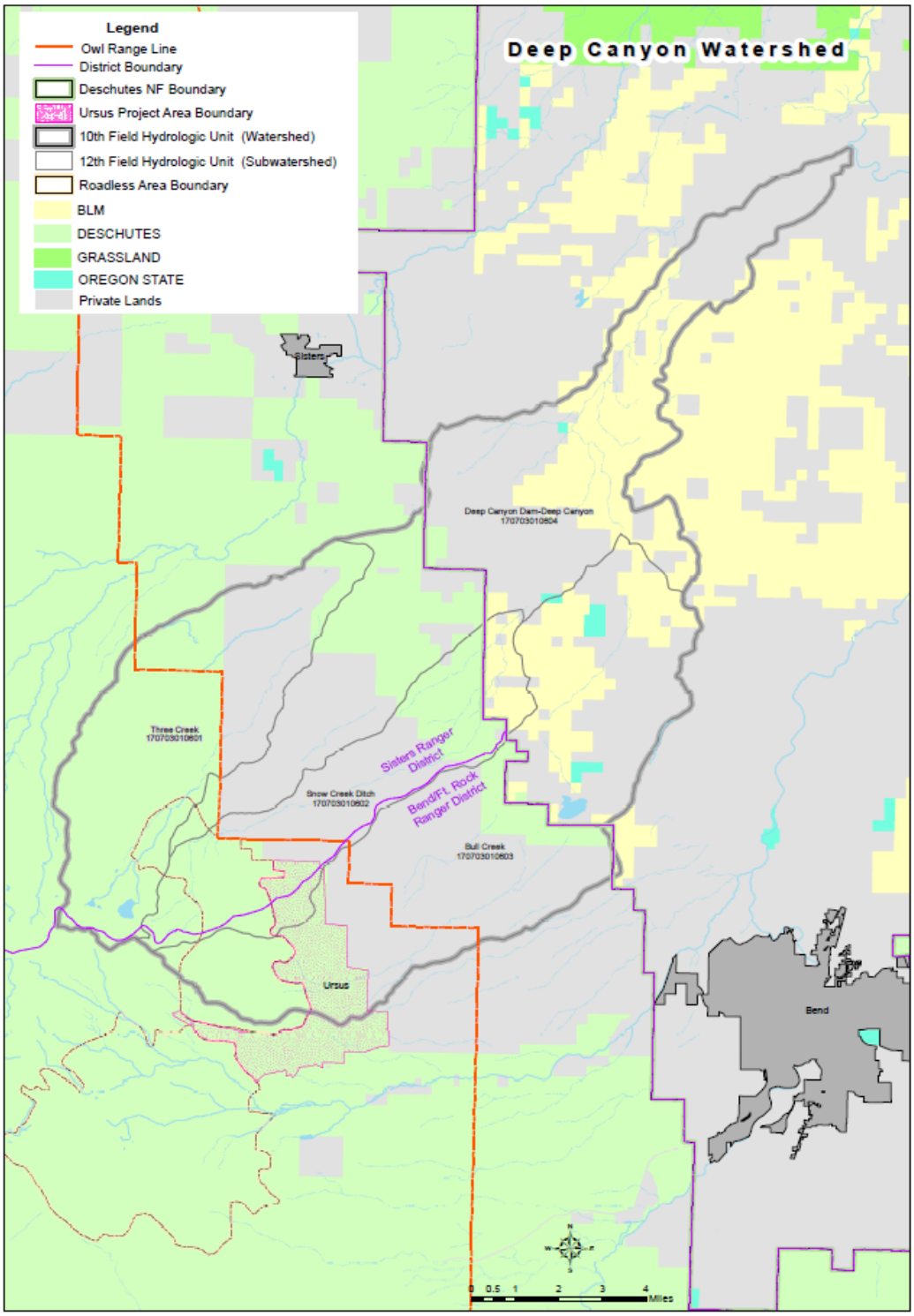
The analysis area is located approximately 8 miles west of Bend, Oregon in the Bend/Fort Rock Ranger District and on private lands (Figure 2, page 10). Elevations range from approximately 5,600 feet at the divide with the Tumalo Creek watershed, to 3,250 feet at the NE portion located on private land.

The 12th field Bull Creek subwatershed (170703010603) is 32,153 acres and is one of 4 subwatersheds that comprise the 10th field Deep Canyon Watershedn(1707030106). Approximately 19,316 acres (60%) are within the Deschutes National Forest (DNF) boundary. Within the DNF boundary are approximately 7,225 acres of federal land and 12,090 acres of private land. Approximately 12,837 (40%) acres are other ownership (Private, BLM, State) east of the DNF boundary. The sub-watershed includes national forest lands both west and east of the Northern spotted owl range line, to be managed in accordance with the Northwest Forest Plan and the Eastside Screens and INFISH, respectively.

The 1,378,755 acre Upper Deschutes sub-basin is one of 15 sub-basins within the 16,918,308 acre Deschutes River Basin. The Deschutes River Basin is approximately 140 miles from north to south. The Deschutes River enters the Columbia River to west of The Dalles near Celilo. At this point, the Columbia River is approximately 190 miles upstream from its confluence with the Pacific Ocean.

Western tributaries to the Deschutes River drain the wetter, cooler slopes of the High Cascades with rainfall generally over 100 inches per year. Eastern tributaries drain the more arid lands that are influenced by the Cascade rain shadow, with rainfall ranging from 9-14 inches.

Figure 2: Vicinity Map for the Bull Creek Watershed Analysis



The Deschutes River below the confluence of the Crooked River is characterized as a stable core habitat connected to tributaries with strong environmental gradients of flow, temperature and stability. High flows have little effect on the physical habitat of the lower Deschutes River, which is influenced by dams, making it one of the most stable rivers in the northwest (Lichatowich, et al. 1998). The Upper and Lower Deschutes River are managed as separate ecosystems. However what occurs up river eventually influences the lower.

The Deschutes River provides habitat for anadromous fish species, allowing them to reach the interior Deschutes River streams for spawning and rearing up to Lake Billy Chinook. Passage is blocked above Lake Billy Chinook by the Pelton-Round Butte dams and fish are trucked around the dams.

CLIMATE

Central Oregon

The Deep Creek Watershed Analysis Area experiences a climate typical of Central Oregon. There is a prolonged cool wet period from November through May then it is followed by a hot dry season which normally extends from June through October.

The Cascade Mountain Range acts as a barrier to the movement of moisture into the interior of Oregon. The rain shadow from the Cascades to the analysis area affects the temperature and moisture important to the watershed's vegetative potential. Annual precipitation within the watershed averages 20.8 inches a year. This ranges from 12 inches at lower elevations to 33 inches at the highest. Yearly averages can vary as much as 40%, Seventy percent of the precipitation occurs between November and April in the form of snow. Above 4,500 feet a snowpack accumulates. In Spring, this snowpack is the main contributor to seasonal peak flow. Snowpack is a very important factor of ground water re-charge which maintains base flow during the dry season..

Relative humidity is often in the single digits during the latter part of the summer months, particularly during August. Generally low elevation, south aspects are hot and dry. On north aspects conditions are relatively cool and moist. Elevation and aspect conditions influence micro-climate and vegetative response. Northern aspects stay in snow for longer periods of time than the more southerly facing aspects.

Climatic Patterns

Convective thunderstorms are fairly common in the spring and summer, and occur on average about 14 times a year in this part of the state (Western Region Climate Center). Summer thunderstorms can cause from 0.3 to 0.75 inches of rain to fall within a few hours. This can result in intermittent streams exhibiting water flow.

In winter, the upper level jet stream drops from the north resulting in many storms originating from the Pacific Ocean. Most of the moisture from these storms is trapped by the Cascade Mountains. Other storms occur when a southerly flow aloft combines with low pressure at the surface in eastern Oregon. This combination creates an upper level trough resulting in rain or snow.

Mid-elevations during certain periods of winter and spring are subject to rain on snow events. This condition creates a higher risk for surface erosion. A 'typical' flood episode resulting from a rain on snow event in the Deep Creek Analysis Area occurs when a mass of warm, moist air moves into the area, causing rain to fall on snow rapidly melting the accumulated snow. These periodic runoffs, although uncommon east of the Cascade Crest (rain shadow, more gentle topographic relief, less dissection, more porous soils/geology), can cause intermittent streams to flood their banks. The transient snow zone within the watershed analysis area occurs in an elevation band between 4,500-5,000 feet, covering most of the area.

WATER

There are no perennial streams within the watershed. Intermittent streams provide a channel for spring runoff from snowmelt and large storms. One spring is within the sub-watershed and was dry in July of 2010. There are no Oregon Department of Environmental Quality (ODEQ) water quality impaired water bodies (303)(d)

VEGETATION

Upland forest and woodland plant association groups that are present include: Ponderosa Pine Wet and Dry; Mixed Conifer Wet and Dry; Lodgepole Pine Wet and Dry; and Mountain Hemlock Dry. Plant associations are a method of land classification that is based on the projected plant community that would occupy a site given enough time and the absence of disturbance.

The Deschutes National Forest's "Viable Ecosystem Management Guide" (VEMG) describes a seral/structural matrix for characterizing forest vegetation within each of the plant association groups. This matrix is a departure

from the classic linear succession models which typically describe succession as a progression through different stages, i.e. early, mid, late, climax. The Deschutes matrix has three seral stages based on species composition (early, mid, late), and each of these is subdivided into five size/structural conditions (grass/forb/shrub, seedling/sapling, pole, small trees, large trees). Thus, the matrix can accommodate up to fifteen cells, each of which represents a different seral (E, M, L) and size/structural (1-5) condition (Table 2).

Table 2: Viable Ecosystem Seral/Structural Matrix

Seral/Structural Component	Early	Mid	Late
Grass/forb/shrub	E1	N/A	N/A
Seedling/sapling (1-4.9" dbh)	E2	M2	L2
Trees – pole (5-8.9"dbh)	E3	M3	L3
Trees – small (9-20.9" dbh)	E4	M4	L4
Trees – large (21"+ dbh)	E5	M5	L5

Note: Matrix cells can be further subdivided to reflect relative differences in tree density. Subscripts "a" and "b" are used to denote high and low density respectively. For example, L4a describes a late seral species composition, small sized trees, at a high density level.

WATERSHED MANAGEMENT DIRECTION

DESCHUTES NATIONAL FOREST MANAGEMENT AREAS

The Deschutes National Forest Land and Resource Management Plan (LRMP), as amended by the Regional Forester's Forest Plans Amendment #2, June 1995 and the Inland Native Fish Strategy, August 30, 1995 (INFISH) establishes goals, objectives, standards, and guidelines (S&Gs) for each specific management area of the Forest, as well as Forest-wide S&Gs. Management Areas and associated S&Gs are described in Chapter 4 of the LRMP.

Subwatershed acres within the range of the spotted owl total 5,395 acres. Subwatershed acres east of the range of the spotted owl total 26,758 acres with 12,838 acres outside the administrative boundary of the Deschutes National Forest under BLM, State, or private ownership. Within the Deschutes boundary, 12,090 are privately owned, primarily as part of the Bull Creek Tree Farm (Skyliner Forest), and 1,831 acres are Deer Habitat (MA-7). The subwatershed (Figure 3, page 14) is dominated by other ownership. Within the analysis area, Front Country is the dominant Management Area.

Table 3: Deschutes Land and Resource Management Plan (LRMP) Management Areas – Designations and Other Land Areas within the Bull Creek Subwatershed and Acres

Deschutes LRMP Management Areas – Within Administrative Boundary		Acres
M-6	Wilderness	152
M-7	Deer Habitat	1,831
M-13	Winter Recreation	276
M-15	Old Growth	358
M-18	Front Country - Unseen	2,482
M-18	Front Country - Seen	2,126
M-30	Other Ownership	12,090
Total LRMP Management Area Acres		19,315
Other Ownership – Outside Administrative Boundary		12,838
Total Subwatershed Acres		**32,153**

LRMP MANAGEMENT AREA DESCRIPTIONS

Wilderness (MA 6 – 152 acres): To feature naturalness, opportunities for solitude, challenge, and inspiration, and within these constraints to provide for recreational, scenic, scientific, educational, conservation, and historical uses.

A portion of the Three Sisters National Wilderness Area is located at the western end of the subwatershed.

Deer Habitat (MA 7 – 1,831 acres): To manage vegetation to provide optimum habitat conditions on deer winter and transition ranges while providing some domestic livestock forage, wood products, visual quality and recreation opportunities (LRMP, page 4-113).

- Deer Habitat is located along the eastern boundary of the Forest Service administrated lands.

Winter Recreation (MA 13 – 276 acres): To provide quality winter recreation opportunities within a forest environment that can be modified for visitor use and satisfaction (LRMP, page 4-143).

Old Growth (MA 15 – 358 acres): To provide naturally-evolved old growth forest ecosystems for (1) habitat for plant and animal species associated with old growth forest ecosystems, (2) representations of landscape ecology, (3) public enjoyment of large, old tree environments, and (4) the needs of the public from an aesthetic spiritual sense. They will also contribute to the biodiversity of the Forest (LRMP, page 4-149).

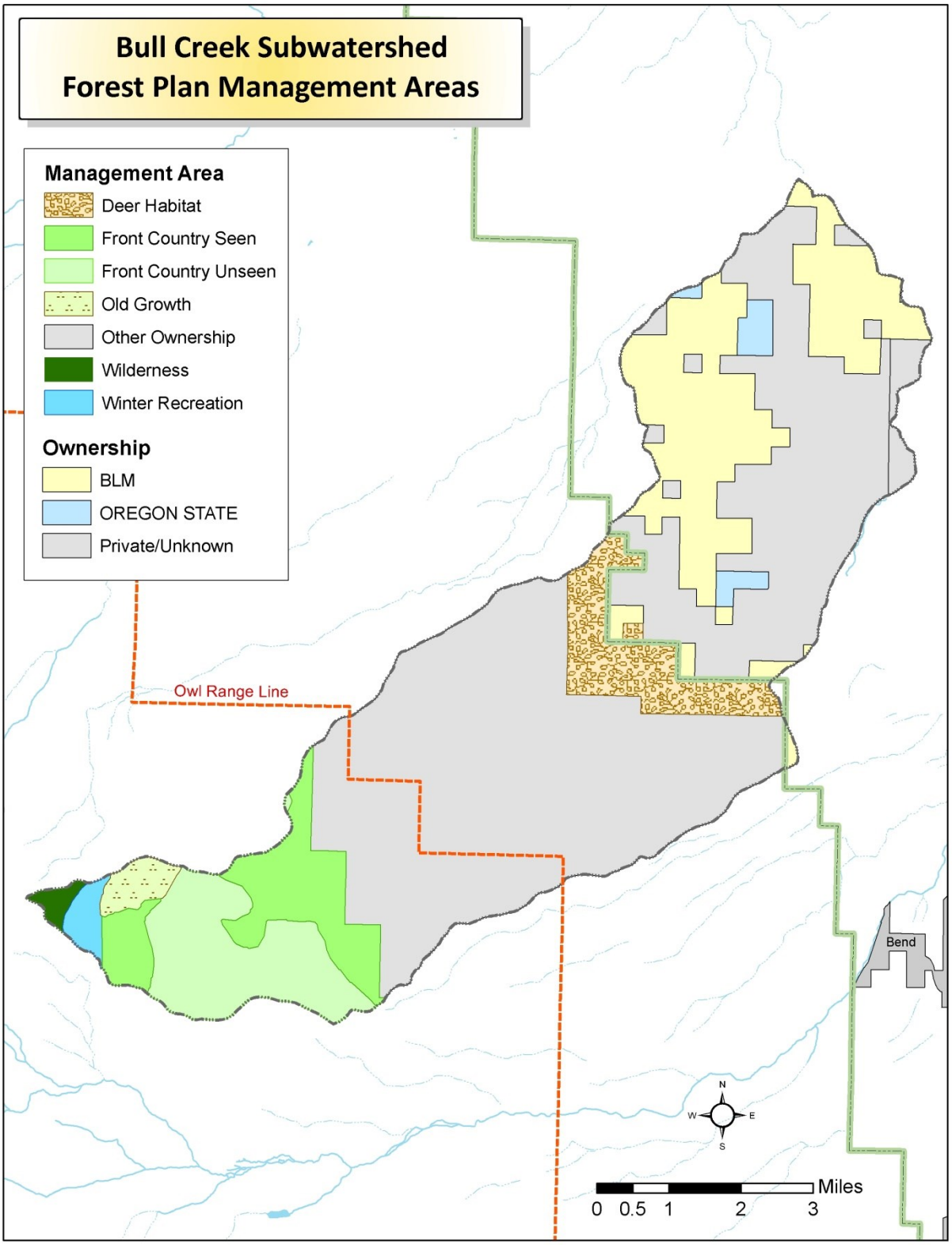
Front Country (MA 18 – 4,608 acres): To provide and maintain a natural appearing forested landscape on the slopes northest of the Three Sisters and Tam MacArthur Rim whild providing high ans sustainable levels of timber production (LRMP, page 4-159).

This area is located between Deer Habitat and Wilderness and includes Seen and Unseen Front Country.

- **Seen**: The desired condition is a landscape where color contrasts are minimal and the full crowns of younger trees create a visually uniform, primarily dark gree, gently rolling landscape. Management activities should not result in shapes or lines that are visible from significant view locations. Openings and textural changes are and should be, generally small and remain subordinate in this landscape except during the winter months, when snow, weather and lighting conditions exzaggerate color contrasts makin oopenings more evident.
- **Unseen**: Portions which cannot be seen from the significant view locations will be managed similarly to land in General Forest.

Other Ownership (MA 30 – 24,926): The area located between Deer Habitat and the NWFP designated Matrix lands to the west and the non-Forest Service administered lands to the east is other ownership (Private – Skyline Forest lands = 12,090 acres; other private = 7,191 acres; BLM = 5,236 acres; State = 409 acres).

Figure 3: Bull Creek Subwatershed LRMP Management Areas.



NORTHWEST FOREST PLAN

In 1994, the Record of Decision for Amendments to the Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl (USDA 1994) amended the LRMP. Standards and Guidelines from the Deschutes LRMP (USDA 1990) apply where they are more restrictive or provide greater benefits to late-successional forest related species than other provisions of the NWFP S&Gs (NWFP, page C-2). Approximately 5,394 acres of Forest Service administered lands lie west of the Northwest Forest Plan owl line.

Table 4: Northwest Forest Plan Allocations with LRMP Management Areas and Acres

Northwest Forest Plan Allocation	Corresponding LRMP MA	Acres
Congressionally Reserved	Wilderness	152
Administratively Withdrawn	Winter Recreation	276
	Old Growth	358
Matrix	Front Country Unseen	2,482
	Front Country Seen	2,126
Total Acres		**5,394**
Matrix	Private	3,244
Total Acres		**8,638**

NORTHWEST FOREST PLAN ALLOCATION DESCRIPTIONS

Administratively Withdrawn (634 acres): Administratively Withdrawn areas are identified in current Forest Plans and include recreation and certain visual retention and riparian areas, and other areas where management emphasis precludes scheduled timber harvest and which are not included in calculations of allowable sale quantity (NWFP C-19). In the analysis area, Old Growth and Winter Recreation MAs are Administratively Withdrawn.

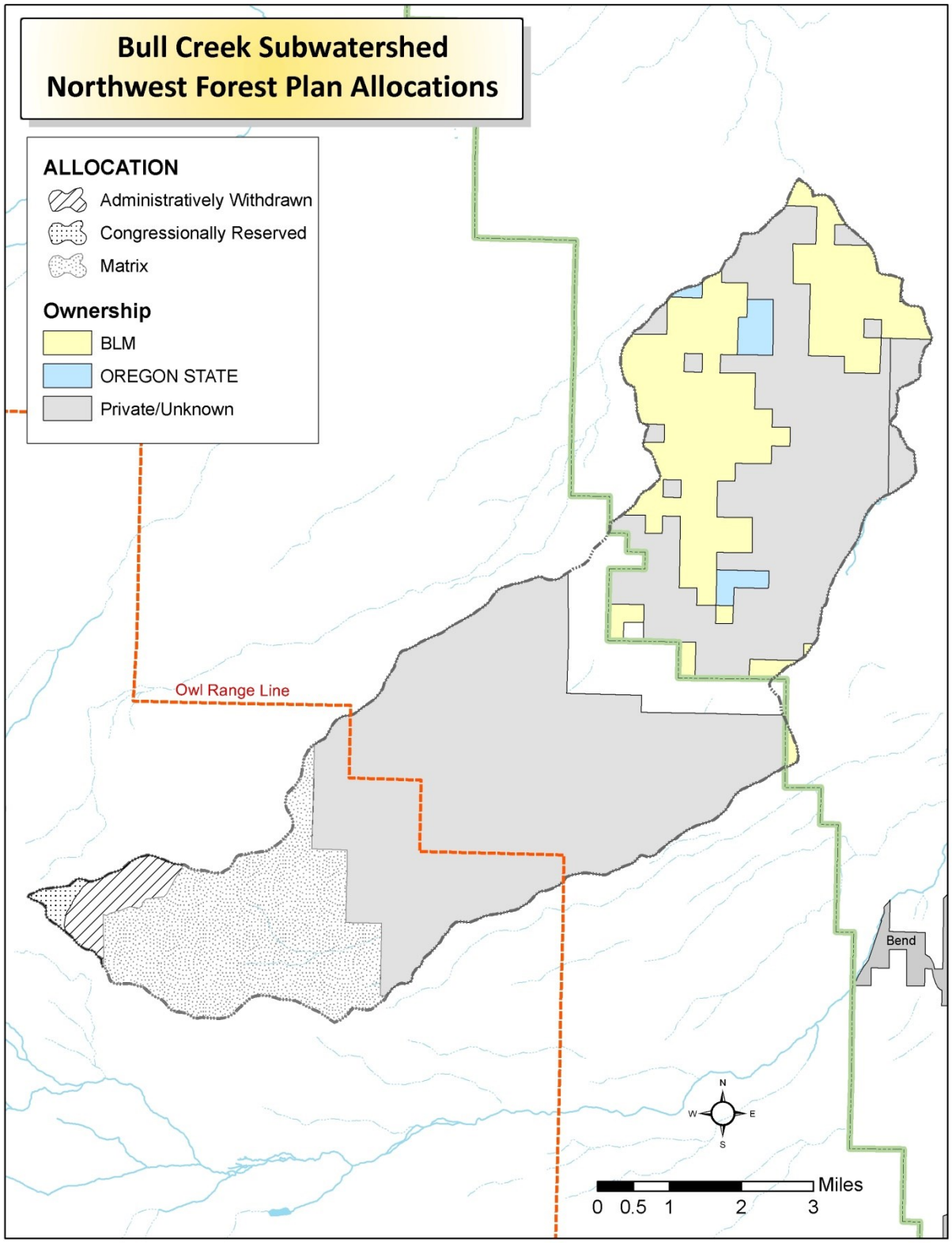
Congressionally Reserved (152 acres): These include lands with congressional designations that preclude timber harvest, as well as other federal lands not administered by the Forest Service or BLM. This includes…Wildernesses…. In the analysis area, the Wilderness MA is within Congressionally Reserved.

Matrix (4,608 acres): The matrix consists of federal lands outside the categories listed above. Most timber harvest and other silvicultural activities would be conducted in that portion of the matrix with suitable forest lands, according to standards and guidelines (NWFP C-39). Fire and fuels management in the matrix can reduce the risk of fire and other large-scale disturbances that would jeopardize the reserves (NWFP B-8).

Production of timber and other commodities is an important objective for the matrix. However, forests in the matrix function as connectivity between Late-Successional Reserves and provide habitat for a variety of organisms associated with both late-successional and younger forests. S&Gs for the matrix are designed to provide for important ecological functions such as dispersal of organisms, carryover of some species from one stand to the next, and maintenance of ecologically valuable structural components such as down logs, snags, and large trees. The matrix will also add ecological diversity by providing early successional habitat (NWFP, B-1 and B-2). In the analysis area, the Front Country Seen and Unseen MA is within Matrix.

Private Fidelity Lands (3,244 acres): These are the lands that are adjacent to USFS administered lands (Matrix) that are within the NWFP boundary.

Figure 4: Northwest Forest Plan Land Allocations. Approximately 5,395 acres (17%) of the Subwatershed are West of the Owl Line, Mostly Within Matrix.



INFISH

The Inland Native Fish Strategy, August 30, 1995 (INFISH) established Riparian Habitat Conservation Areas (RHCAs) primarily to reduce the risk of loss of inland resident native fish populations and the negative impacts to their habitat on National Forest System lands. INFISH provided riparian management objectives, standards and guidelines, and monitoring requirements. RHCAs occur within all land allocations and generally parallel the stream network. There are no perennial streams within the subwatershed.

ROADLESS AREA CONSERVATION

The final Roadless rule prohibits the cutting, sale, and removal of timber in inventoried roadless areas (IRA), except:

- For the cutting, sale, or removal of generally small-diameter trees which maintains or improves roadless characteristics and:
  - To improve habitat for threatened, endangered, proposed or sensitive species or
  - To maintain or restore ecosystem composition and structure, such as reducing the risk of uncharacteristic wildfire.

Summary: This rule was adopted to establish prohibitions on road construction, road reconstruction and timber harvesting in inventoried roadless areas. The intent is to provide lasting protection for inventoried roadless areas within the National Forest System in the context of multiple-use management. Inventoried roadless areas provide a remote recreation experience without the Wilderness activity restrictions (e.g. OHV use and mountain biking). The Bearwallows IRA has 2,770 acres within the subwatershed.

CLEAN AIR ACT

The Clean Air Act designated all Wilderness over 5,000 acres as Class I airsheds. The Three Sisters Wilderness falls into this category. These areas could be affected by fire activity. The State of Oregon also designated Bend as a Smoke Sensitive Receptor Area (SSRA). This additional State designation places Bend under the highest level of protection from air pollution.

CHAPTER 2: KEY ISSUES AND CORE QUESTIONS

The purpose of Issues and Key Questions is to focus the analysis on the key elements of the ecosystem that are most relevant to the management questions and objectives, human values, or resource conditions within the watersheds. Issues, which were identified in both the 1995 Bend WA (which the Bull Creek subwatershed was a part of) and the 2008 Whychus Creek WA, which included 3 of the 4 subwatersheds of the Deep Canyon Watershed (Bull Creek is part of), were considered to be relevant and are incorporated into this analysis.

- Issues were identified as a way to focus on the primary elements of the ecosystem that are most relevant to the subwatershed in terms of resource conditions, management objectives, and human values.
- Key questions were formulated from indicators commonly used to measure or interpret critical ecosystem elements.
- The issues and key questions were then used to identify resource management concerns and trends as a way to provide a basis for management recommendations in Chapter 6.

Natural disturbance processes such as wildfire, insects, disease, landslides, and erosion affect change in vegetation patterns, and species distribution. Understanding these natural disturbance processes allows us to determine the relative effect and importance of human disturbance patterns on ecosystem conditions.

Human disturbances within the Bull Creek sub-watershed analysis area such as timber harvest, road development, and fire exclusion have affected the natural rates of change and function of certain ecosystem elements.

Areas of concern this analysis will focus on include:

- Vegetative densities and associated fire hazard and susceptibility to insect and disease,
- Forested vegetation as related to Historic Range of Variability;
- Management implications associated with species of concern known, or expected to occupy the watershed analysis area;
- Distribution and condition of herbaceous and shrubland forage and their relationship to wildlife, and plant habitats and their function;
- Abundance and distribution of noxious weeds;
- Recreation multiple use and access needs for camping, hunting and tribal use;

This watershed analysis explores the patterns of disturbance and the extent of impacts on the elements of the ecosystem. By determining patterns of human induced disturbance in context with natural disturbance processes, watershed restoration projects can be recommended.

The primary resource issues that this WA will focus on and each resource will discuss in Chapter 3 (Historic and Current Conditions) are:

KEY ISSUES

Fuels

- Fire exclusion and natural succession have changed the historical fire regime and reduced the ability to suppress wildfire. This includes the difficulty of initiating treatment within wilderness and inventoried roadless areas,
- Forest resilience to fire, insects and disease, as a result of fire exclusion, has diminished as stand densities increase and shade tolerant species populate warm and dry sites.

Vegetation

- Increases in extensive areas of lodgepole pine mortality caused by mountain pine beetle resulting in increased fire risk, loss of late and ole growth structure, and impacts to scenic quality and recreation.
- Increases in shade tolerant species in mixed conifer forest types.

Botany

- Increasing disturbance and the continued introduction of seed sources have caused populations of noxious weeds to increase.

Wildlife

- Risk of loss of the Tumalo winter range (Deer Habitat) to fire
- Wildlife habitat fragmentation

Recreation

- Impacts to vegetation and scenic integrity due to increases in Off Road Vehicle (OHV) use, especially within Deer Habitat.
- Effects of use on carrying capacity of Wilderness and Inventoried Roadless areas.

Scenic Quality

- Impacts on scenic views to landmarks and mountains from activities or events (such as logging, road construction, wildfire, and mortality from insects).
- Expectation of the public for scenic quality in wilderness, roadless, and undeveloped areas.

Soil Quality, Sensitivity, and Resilience

-
- Of greatest concern are the potential impacts to soil from a severe wildfire, primarily, the effects of erosion. The issue is the trade-off of treating stands and incurring soil impacts versus not treating stands and incurring uncontrolled ground impacts from high intensity wildfire.
- Soil impacts in the form of compaction and erosion in heavily used OHV recreation areas has resulted in a decrease in the soils ability to function in a desirable manner.
- The cumulative soil impacts from multiple vegetation management activities in the same area may results in detrimental soil conditions which exceeded those Standards listed in the Regional Soil Quality Standards.

Heritage

- What know prehistoric and historic sites are within the watershed analysis area and what impacts have occurred to these sites from management and recreation activities

ISSUE DISCUSSION

ISSUE 1: FOREST SUSTAINABILITY AND RESILIENCY

Background

Forest resilience to insects and disease agents has diminished as stand densities have increased and shade tolerant species populate warmer and drier sites, a result of practices such as fire exclusion and selective harvesting. Vegetative conditions include an extensive area of unfragmented forest at mid and upper elevations, a loss of large tree structure at lower elevations, and forest encroachment in meadow areas. Mid-elevation, dry mixed conifer stands are the most substantially affected by an increase in density, including a potential loss of large trees from increased competition and a greater risk of stand replacement fire.

Past management activities within the mid-elevation, lodgepole pine stands have been relatively minimal, few stand management treatments have been implemented in the past 20 years. Lower elevation ponderosa pine stands (mostly on private land) have been heavily harvested in the past, with railroad era clearcuts creating large blocks of middle-aged forests that are found today. Most treatments have occurred within the stands located on lands owned and currently managed by Crown Pacific. Most of these stands are more resilient to insect agents where densities have been reduced, although they are still somewhat at risk to fire disturbance due to the uniform crown cover and shrub component. Increased access provided by a much greater road network on private lands can allow for faster fire suppression response times on the ground.

Key Questions

1. How do we maintain an existing unfragmented landscape in the mid-elevation stands while reducing the risk of insect epidemics and stand replacement fire events?

Difficulties exist in maintaining an unfragmented landscape that was naturally disturbed through fire cycles and insect and disease agents. Realistically, most proposed situations would actually trade one kind of fragmentation for another. Active management would create smaller, patch size openings and passive management would result in larger areas of disturbance from insects and disease or from stand replacement fires. Fragmentation caused by fire at that scale and level of disturbance opens the potential for another future fire to occur.

In some cases, the desire for passive management of these stands is to maintain important values such as wildlife habitat and positive recreation experiences. Currently, the stands are relatively healthy although the risk of loss due to stand replacement fire events would continue to increase over time, altering conditions and how those resource values are utilized.

2. What fire risks exist due to present fuel loadings?

Fire risk is moderate to high for this area although the potential for large fires is mitigated to some degree by the close proximity of the subwatershed to the Redmond Air Center (RAC). The risk of fire continues to increase over time as the upper extent of natural fire return intervals in these forest types are approached or exceeded and fuels continue to build. Fires that do occur are likely to be stand replacement events capable of exposing extensive areas of bare mineral soil susceptible to erosion on steeper slopes from rainfall and snowmelt.

3. What stand would benefit from stocking level (density) reduction to promote stand resilience?

Drier forest types, such as dry mixed conifer and ponderosa pine stands would benefit most from stocking level reduction by improving vigor in residual trees. Moist or upper elevation cold forest types would receive the least benefits. Lodgepole pine may benefit from increased density, especially in more mesic zones although these types are considered to have fewer economical benefits. Stands within the mid-elevation zone appear to have the least amount of change from natural disturbance regimes, although the risk of larger scale fire disturbances is increasing. Current trends in land management, with continued fire suppression, would create a greater number of older forests with fewer openings that may have existed historically.

4. Where can conifer encroachment in wetlands be reduced?

One spring exists within the subwatershed. Treatments can occur immediately adjacent to the spring to reduce stand density and removal of trees that have encroached during the past several years.

ISSUE 2: PROTECTION OF WILDLAND URBAN INTERFACE WITH INCREASING FUEL LOADS AND FIRE RISK.

Key Questions

1. How do we implement Hazardous Fuel Reductions (HFR) within the Community Wildfire Protection Plan (CWPP) boundaries to protect private land in holdings and provide ingress/egress while maintaining other forest resources including wildlife habitat, water quality, soil resources, and recreational activities?

Two CWPPs are relevant to the watershed; the Greater Bend CWPP (2006) and the East and West Deschutes County CWPP (2007).

Both CWPPs included the following in the purpose:

- Protect lives and property from wild land fires;
- Instill a sense of personal responsibility for taking preventive actions regarding wild land fire;
- Increase public understanding of living in a fire-adapted ecosystem;
- Increase the community's ability to prepare for, respond to and recover from Wild land fires;
- Restore fire-adapted ecosystems; and
- Improve the fire resilience of the landscape while protecting other social, economic and ecological values.

The East and West Deschutes County CWPP also includes the following goals and purpose:

- Provide guidance to federal agencies for implementing fuels reduction treatments;
- Prioritize the use of limited funds for the treatment of hazardous fuels;
- Promote biomass utilization.
- In stands of mixed conifer and lodgepole with the volatility of Condition Class I on a fire prone landscape, reduce extreme fire behavior for firefighter and public safety.

Greater Bend CWPP

The sub-watershed overlaps a portion of the West (rank 4 of 10) and the North (rank 8 of 10) "Communities at Risk" as identified in the CWPP. To rank the 10 Communities at Risk in the Greater Bend Community Wildfire Protection Plan, two risk assessment methodologies were utilized: the Oregon Department of Forestry Assessment of Risk Factors and a combined risk assessment that considers Fire Regime - Condition Class, Fire Starts & Large Fire History. A composite rating using the two methodologies ranked West (rank 4 of 10) and the North (rank 8 of 10), placing West in the second of and North in the third of the three priority categories.

East and West Deschutes County CWPP

This CWPP encompasses the remaining unincorporated and/or unprotected wildland urban interface areas in Deschutes County not included in the six existing CWPPs, including the Greater Bend CWPP.

Hazardous Fuels Reduction

The ability to conduct hazardous fuel reduction in the Bull Creek watershed is challenging because of the portion of the South Sister's Wilderness area, the Bearwallows Inventoried Roadless Area, Spotted Owl habitat, high mortality and associated standing dead lodgepole pine, market conditions for providing biomass, and proximity to Bend, Tumalo, Skyliners, and the Three Sisters Class 1 airshed.

Strategic Placement of Treatments (SPOT)

The SPOT process allows resource managers, the public, and partners to participate and collaborate in NEPA planning. Key components of the process include: 1) definition of the analysis area, 2) identification of assets and protection targets, 3) definition of the "Problem Fire", 4) design of treatment

patterns to mitigate a problem fire and meet a range of objectives, 5) test treatment patterns with FlamMap, then adjust and re-test, 6) display the trade-offs, and 7) follow-up with monitoring/adaptive management.

FlamMap is a fire behavior mapping and analysis program that computes potential fire behavior characteristics (spread rate, flame length, fireline intensity, etc.) over a landscape for constant weather and fuel moisture conditions.

It is recommended that the SPOT process and FlamMap be utilized to evaluate potential treatment locations.

2. What kinds of treatments can be implemented in the CWPP boundary and how do we evaluate their potential effectiveness?

Treatment Options

Opportunities for treatment within the CWPP are limited to thinning, mowing, and underburning. These areas are primarily ponderosa pine and relatively flat ground. The proximity to private land, developments, communities, and a Class 1 airshed could limit burning treatment options.

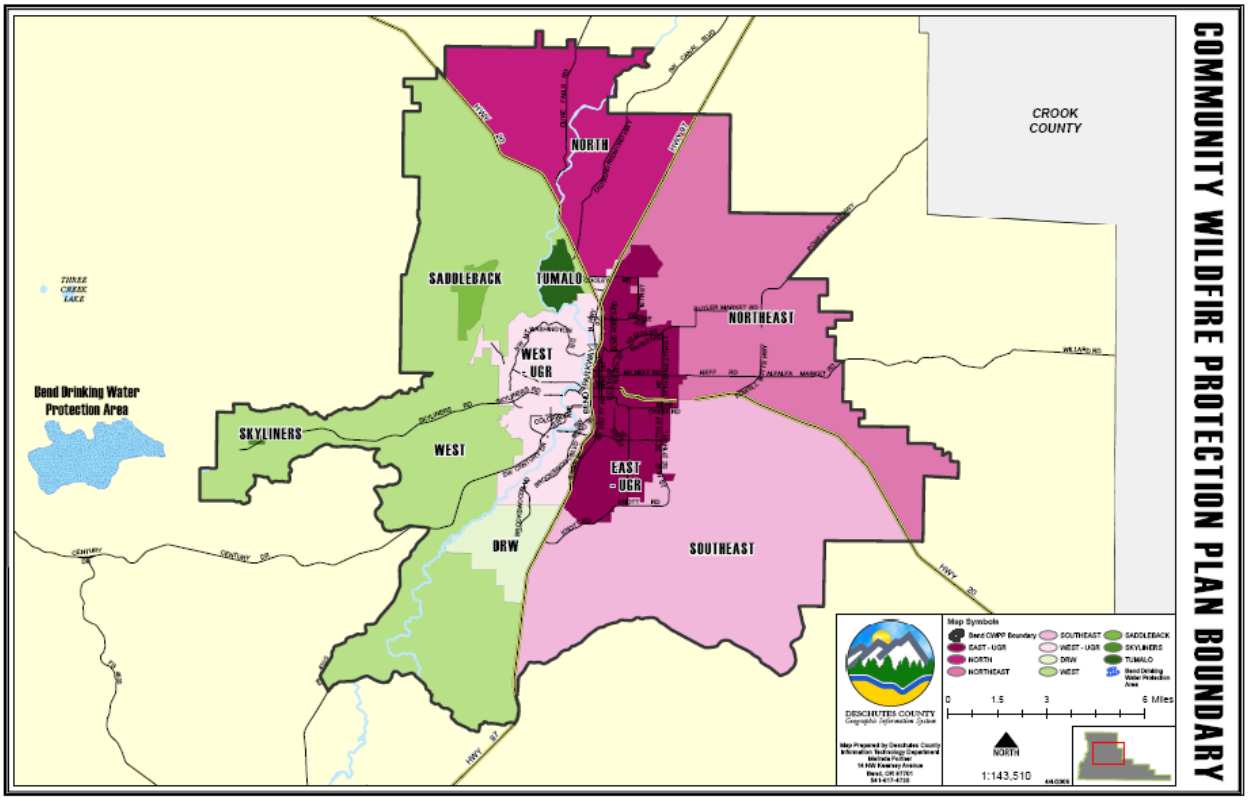
Evaluation of Effectiveness

Treatment units within the watershed will be monitored as part of the Central Oregon Fire Management Service monitoring program, using the FireMon protocol, which meets national standards.

The CWPPs also identified a process for monitoring and evaluation:

- Identify and assess new or treated risks.
- Evaluate and track progress toward goals, and update maps.
- Adopt new and/or revised priorities, with specific projects.
- Identify specific fuels treatment projects.
- Identify appropriate projects to decrease structural vulnerability, address issues with evacuation routes, condition of roads, and water supply.

Figure 5: Greater Bend Community Wildfire Protection Plan Boundary



ISSUE 3: PROTECTING RESOURCE VALUES WHILE MAINTAINING A QUALITY RECREATION EXPERIENCE WITH APPROPRIATE USE LEVELS AND ACCESS.

Background

Soil quality within the watershed has been affected in some areas by compaction from recreational uses, primarily user created OHV trails. Most OHV use occurs on existing roads, with no designated routes within the subwatershed. Wildlife populations and habitat may also be adversely impacted from increased recreation use and urban development within the subwatershed.

Key Questions

1. **What management actions are necessary to minimize the risk for detrimental impacts from uses radiating from Forest roads 4602, 4606, and 4607 and recreation use and development of user created trail systems?**

Risks for detrimental road-related impacts can be minimized through: surface treatment and spot hardening; enforcement of road closures with seasonal closures to allow dry season use only; and monitoring recreation uses and associated impact levels in order to repair/restore damaged or compacted areas.

2. **What kinds of recreation use conflicts between users or with resources need to be prevented or resolved?**

Current recreation users are primarily mountain bikers, horseback riders, and snowmobilers. A horse trail begins at Rock Springs Guest Ranch, as authorized through a special use permit. Conflicts between users appear to be minimal in the various areas of the subwatershed, partly as a result of the Federal/private land design. Resource impacts from recreation use are primarily associated with soil erosion and loss of vegetation.

3. What limits to recreation use would protect wildlife habitat?

Deer Habitat Standards and Guides prohibit use of motorized vehicles from December 1 through March 31 through a seasonal closure. Trail signing and rerouting within Deer Habitat would help to educate the public regarding the importance of Deer Habitat and reduce intentional and unintentional harassment to deer during the time that energy reserves are critical for survival and reproductive success.

CORE QUESTIONS

The WA process identified in the Federal Guide also provides core questions to help focus the analysis on the following topics: Fuels, Vegetation, Species and habitats, Soils, Scenic Views and Human uses. Through review of the issues, the interdisciplinary team determines the applicability of the core questions, and to what detail they need to be answered. Additional key questions were also formulated for the issues. The core and key questions used for focusing this analysis are listed below.

Fuels

- Where is it appropriate to re-introduce fire as a tool?
- How do we restore resiliency to these fire regimes to minimize the risk and/or impacts of uncharacteristic disturbance events (i.e. fire, insects, and disease)?
- How do we create and maintain conditions that are conductive to important resource values including, but not limited to, wildlife habitat, scenic views. Recreational opportunities and wilderness values?
- What are the local communities of interest?
- How do we establish and maintain safe access for the public and firefighters?
- How do we protect resources that we consider important, while maintaining resiliency from disturbance events?

Vegetation

- What is the historic array and landscape pattern of plant communities and seral stages in the watershed?
- What processes caused these patterns (i.e. fire, wind, mass wasting, insects/disease)?
- What affect is the change in stand conditions resulting from lodgepole pine mortality having on late and old growth structure?
- What is the increased risk in stands of ponderosa pine and other early serial tree species due to increases in shade tolerant species?
- How much affect will the increase in shade tolerant species have on the growth of intermediate tree sizes?

Botany

- What is the relative abundance and distribution of plant species of concern that are important in the watershed (threatened or endangered species and special status species)?
- What are the threats to sensitive plant habitat quality in the watersheds?
- Where are the populations of noxious weeds in the watershed?
- What is the potential for noxious weeds populations to increase?
- What can be done to limit or reduce populations of noxious weeds?

Wildlife

- How do we maintain north-south connectivity for northern spotted owls?
- How dower maintain high quality wildlife habitat as upland recreation activities increase risk of disturbance?
- How do we maintain migratory routes for deer and elk?

Recreation

- What will the public tolerance level be of Wildland Urban Interface (WUI) treatments verses non-WUI treatments?
- What will be the acceptance by the public of vegetation treatments to reduce effects of mountain pine beetle or to reduce fuel loadings in areas of recreation use?
- What level of risk will the public accept for the potential of large wildfires to occur?
- How is the increased use and lack of budget affecting the recreation experience?
- Is the District meeting ROS, Forest Plan, and NWFP standards?
- What effect do road closures have on recreation management (opportunities and constraints)?

Scenic Quality

- What affect is the change in stand conditions resulting from lodgepole pine mortality having on scenic quality?

Soil Quality

- What is the inherent soil quality within the watersheds?
- Where are the sensitive and resilient soils located in the watersheds?
- How has the dynamic soil quality been affected by forest management activities?
- Has there been a change in the inherent and or the dynamic soil qualities since the previous WAs were completed?
- What are the historical and dominant erosion processes within the watershed (e.g., surface erosion processes, mass wasting)?
- Where have dominant erosion processes occurred or likely to occur in the watershed?
- Are there signs of accelerated erosion in the watersheds?

Hydrology

- What are the historical hydrologic characteristics (e.g., total discharge, peak flows) and features (e.g., cold water seeps, ground-water recharge areas)?

Cultural Resources

- What have been the historical uses of the area of analysis?
- What areas, if any, contain evidence of prehistoric use?
- How might recreation use be affecting sites or potential areas of historic and prehistoric uses?
- How would vegetation management potentially affect historic and prehistoric sites?

CHAPTER 3: HISTORIC AND CURRENT CONDITIONS

VEGETATION

PLANT ASSOCIATIONS

Vegetative composition is an important component in understanding, analyzing, and evaluating the physical, biological, and social processes of climate, geomorphology, plant succession, and disturbance events yield changes in vegetative composition and trend (species, structure, density). Climate, soils, and topography generally remain constant over time. Succession and disturbance continually work in concert to change the vegetation condition, both in terms of structure and distribution, as well as in processes and ecological function.

Plant associations are an organizing framework for establishing known vegetation species ranges and were used in the analysis. Species distributions and their potential distribution range have been mapped for the entire watershed. These plant associations vary from cold, upper region, dominated by mixed conifer/lodgepole pine to warm, dry ponderosa pine stands found throughout the lower elevation.

Broadly categorized into plant association groups (PAGs), 6 general communities of forest vegetation emerge. These are: ponderosa pine dry/wet (PPD/W), mixed conifer dry (MCD), mixed conifer wet (MCW), Lodgepole pine dry/wet (LPD/W), and mountain hemlocks dry (MHD). A minimal acreage (30 acres) classified in the juniper PAG has been included within ponderosa pine PAG (Table 5 and Figure 6, page 27)

Table 5: Plant Association Groups (PAG) in the Bull Creek Subwatershed

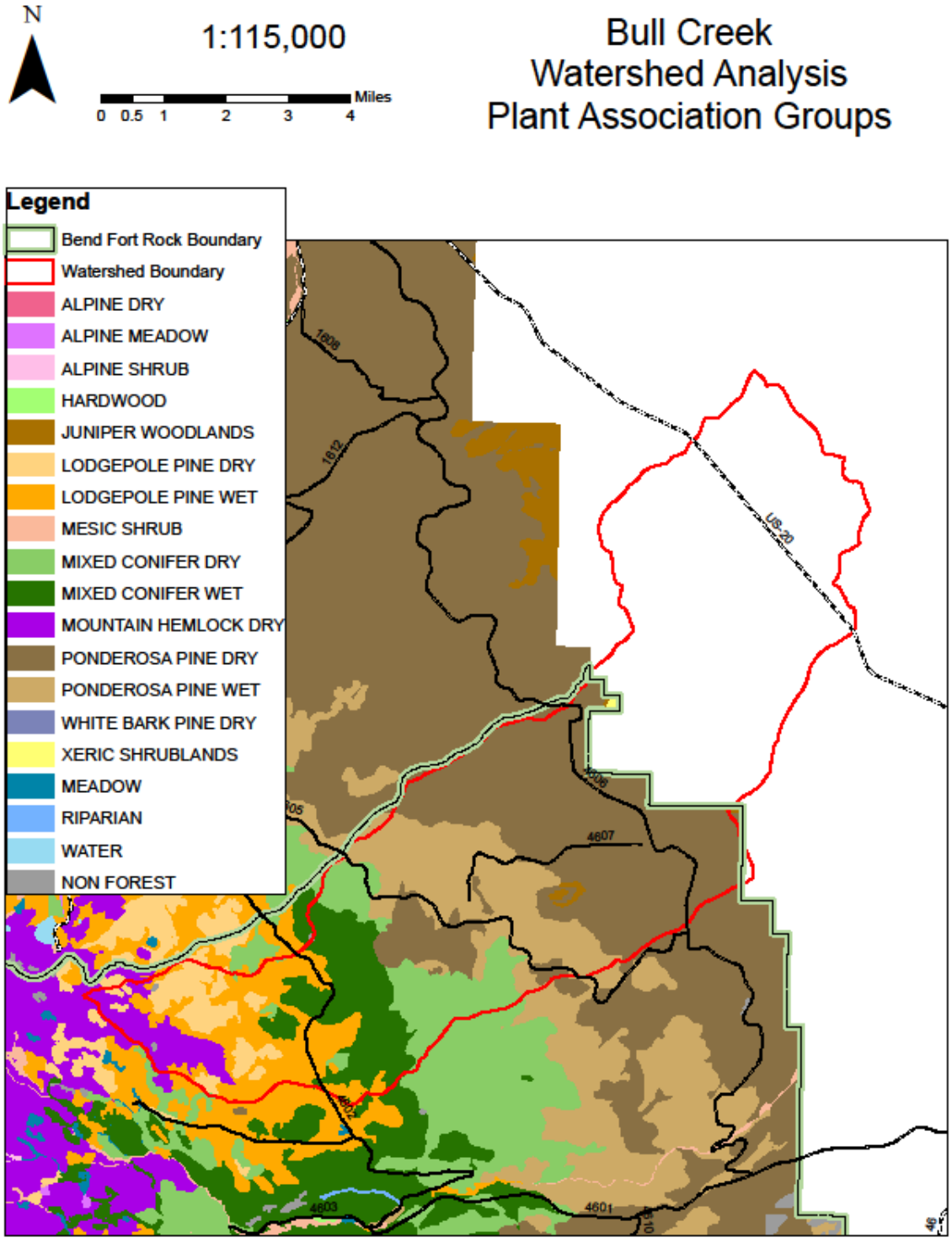
PAG	% of Total Landscape	Dominant tree Species
PPD/W	55%	Ponderosa pine
MCD	15%	Ponderosa pine
MCW	10%	White fir
LPD/W	16%	Lodgepole pine
MHD	4%	Mt. hemlock
TOTALS	**100%**	**All Species**

HISTORIC OR REFERENCE CONDITIONS

The following discussion summarizes the differences between the current forested vegetation conditions and those conditions thought to exist under native disturbance cycles in previous centuries. Where possible, explanations of reasons for those differences are given.

The historic vegetation in this section is based on estimates of reference conditions, in order to establish a general picture of probable landscape conditions under native disturbance regimes. This is set to conditions that most likely existed prior to European settlement, when fire dominated conditions are thought to have existed (circa 1850-1910). This procedure, termed historic range of variability (HRV) analysis, was completed using the Vegetation Dynamics Development Tool (VDDT, Hann et al. 1997) successional pathway model to establish likely reference points.

Figure 6: Bull Creek Subwatershed Plant Association Groups (PAGs)



Structural Stage Classifications

Forest structures and species composition (often termed seral stage) provide a basis for describing both the existing condition of the landscape, as well as the theorized condition under more native disturbance cycles (e.g., conditions under which the landscape is believed to have evolved prior to fire suppression, timber harvesting, and road building for example). In order to simplify the analysis, three structural stages have been assigned and are described as follows:

Early structural stages are newly establishing stands. The early structural stage (SS1) is less than 30 years old. Middle structural stages are those stands that are neither young nor old, but are middle-aged, such as the "second growth" ponderosa pine stands that dominate the environment on the lower portions of the watershed, closest to the urban interface with Bend. The mid structural stage for all species except lodgepole pine (SS2, 3, 4, 5) is between 30 and 130 years old. Mid structural stages for lodgepole pine are 2, 3, 4. Within the subwatershed, late structure stages consist of a) mountain hemlock stands in much of the higher elevations, b) mixed conifer stands in mid-elevations and c) ponderosa pine at lower elevations. The late structural stage for all species but lodgepole pine (SS6, 7) is generally more than 130 years old. Late structural stage for shorter-lived lodgepole pine would normally include structure stages 5, 6, and 7. However, mountain pine beetle outbreaks during the last 20 years have decimated the older lodgepole pine stands within the Bull Creek sub-watershed. As a result of this beetle caused mortality in the older lodgepole pine trees, the older structural stages have been converted to an early seral stage where stand establishment is taking place.

In this procedure, plant community associations and stand structures are projected into the future, for 10, 50, and 100 year projections, and mid-point estimates of species composition and structural classification are made. Simulations of HRV conditions include the most common native disturbance agents (fire, insects, disease pathogens), but more recent disturbance agents (timber harvest, thinning, exotic species) are suppressed).

Table 6: Historic Structural Stages by Plant Association Group (Percentage)

PAG	% of total Landscape	Dominant tree species	Open Areas	Early Structure	Mid Structure	Late Structure
PPD/W	58%	Ponderosa Pine	0%	10%	10%	80%
MCD	13%	Ponderosa Pine	0%	10%	20%	70%
MCW	10%	White Fir	0%	20%	45%	35%
LPD/W	14%	Lodgepole Pine	0%	30%	45%	25%
MHD	4%	Mt. Hemlock	0%	15%	55%	30%
Totals (Range)	**100%**	**All Species**	**0%**	**14% (10-20)**	**27% (20-35)**	**54% (40-65)**

Table 6 was calculated for the 1998 Bend WA. Historic structural stage was not re-calculated for this 2011 update. The 1998 historic structural stage determination was based on a larger area and the historic structural stages developed in 1998 are assumed to remain valid for the smaller 2011 analysis area.

Disturbance Processes

The following discussion centers on the role of disturbance in shaping vegetation patterns, processes, and ultimately trends in the watersheds. Forest vegetation disturbance provides a process to interrupt the ongoing process of succession. There are many disturbance agents present within the watershed area. See Table 9 for dominant historic disturbance by PAG.

Fire: Although no large fires have occurred within the subwatershed, human caused fire starts are relatively common. It is possible that a large fire could occur that would reshape the vegetation/tree component. Further discussion can be found in the Fire/Fuels section of Chapter 3.

Insects and Pathogens: Insects have the potential to cause substantial vegetative changes, resulting in the emergence of new landscape patches and patterns. Ponderosa pine and mixed conifer stands are

imminently susceptible to defoliator insect attacks, as well as to those by bark beetle. Although there is no certainty of these events occurring, there is a greater predisposition for outbreaks to occur, relative to other forest vegetation types, both in terms of structure and composition. Thus, if an outbreak of defoliator or bark beetle species occurs at an epidemic level, then large patches may be created across the landscape, as the ponderosa pine and mixed conifer dominated vegetation zones are the dominant plant associations within the lower portions of the watershed.

Table 7: Dominant Historic Disturbances by Plant Association Group (PAG)

Potential Vegetation(Major PAG)	Dominant Disturbance Factors	Disturbance Intensity	Average Disturbance Size /Patch Created (Acres)	Typical Elevation Zone
Mountain Hemlock	1) Fire 2) Insects and Disease	1) High 2) Low	1) 50-150 2) 50-200	5700'-7500'
Mixed Conifer Dry	1) Fire 2) Insects and Disease	1) Moderate 2) Low	1) 20-300 2) 1-5	4200'-5600'
Mixed Conifer Wet	1) Fire 2) Insects and Disease	1) High 2) Moderate	1) 100-500 2) 100-500	5000'-6200'
Lodgepole Pine Dry/Wet	1) Fire 2) Insects and Disease	1) High 1) High	1) 50-100 2) 10-1000	5000'-6800'
Ponderosa Pine Dry/Wet	1) Fire 2) Insects and Disease	1) Low 2) Low	1) <5 2) <5	3500'-5500'
Riparian and Meadow	Fire	Low	1-50	5500'

Disturbance Regime: Low severity: 1-25 year interval, 0-20 tree mortality; **Moderate severity**: 26-100 yr. Interval, 21-70% tree mortality; **High severity**; >100 year return interval, >70% tree mortality

Root pathogens, in addition to insects have also contributed to landscape patterns and patches. As a root disease center expands, trees on the edges of openings become susceptible to infection and ultimate mortality. Over time, these openings may be colonized by species more resistant to the root disease, thus regenerating a new stand of different composition. Often, species presence, seed production and pathogen specificity limits the re-establishment of the created opening. Lodgepole pine and western white pine are shade-intolerant species typically more resistant to root pathogens that the shade-tolerant firs, thus allowing a mechanism that promotes species diversity over succession advance. Root disease pockets are casually observed in aerial photography within the mountain hemlock zone. Fire patterns currently will differ greatly from historic patches and patterns, simply as a result of chronically increasing stand densities and fuel loadings.

Mountain Pine Beetle: Effects from mountain pine beetle activity continues to be the most significant agent of mortality in recent years. Large expanses of lodgepole pine stands have succumbed to these insect attacks, and mapping has occurred from the 1980's to present with shifting "hot spots" occurring each year. Lodgepole pine dry and wet plant association groups have been hardest to hit and late structural stages of lodgepole pine have been converted to an early structural stage. Interspersed mortality has shown up in the ponderosa pine dry, mixed conifer dry, and some high density mountain hemlock PAGs as well.

Cultural stand treatments can reduce the risk of epidemic beetle attacks before they occur. This necessitates the reduction of density levels to ensure that individual tree health and vigor is maintained. Stand regeneration to a new forest structure can also reduce the potential for beetle attack, and is most appropriate in lodgepole pin stands nearing the end of their natural lifecycles, whether from pathogens of high density stress. Salvaging dead lodgepole pine resulting from such beetle outbreaks can reduce the larger increase in fire hazard, but will not stop the outbreak, as stand conditions that favored the outbreak have not been altered elsewhere (Eglitis, 1996). Much of the lodgepole pine mortality has occurred in the roadless area of the subwatershed where access for vegetation management activities will be limited.

Figure 7: Bull Creek Subwatershed Structural Stages

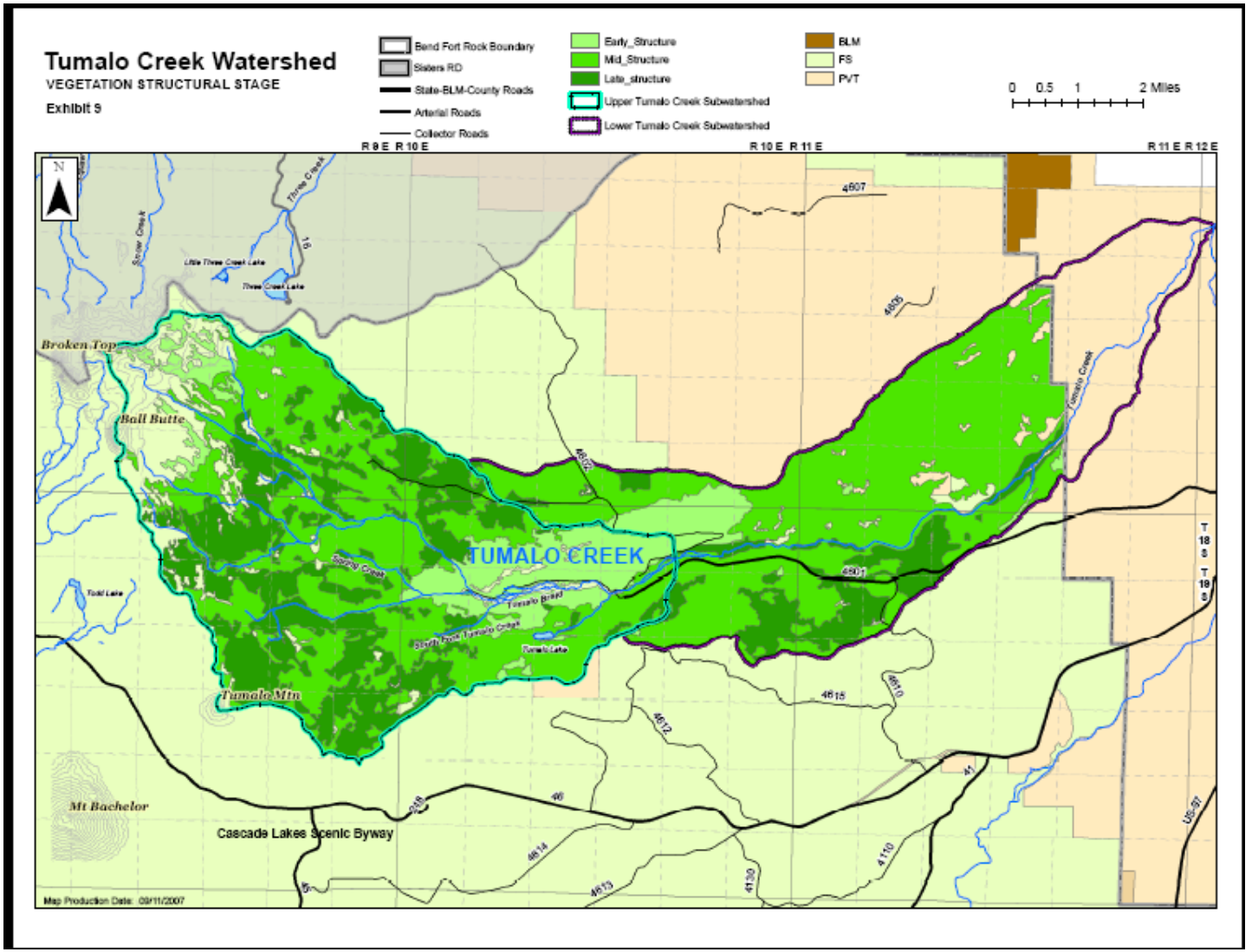
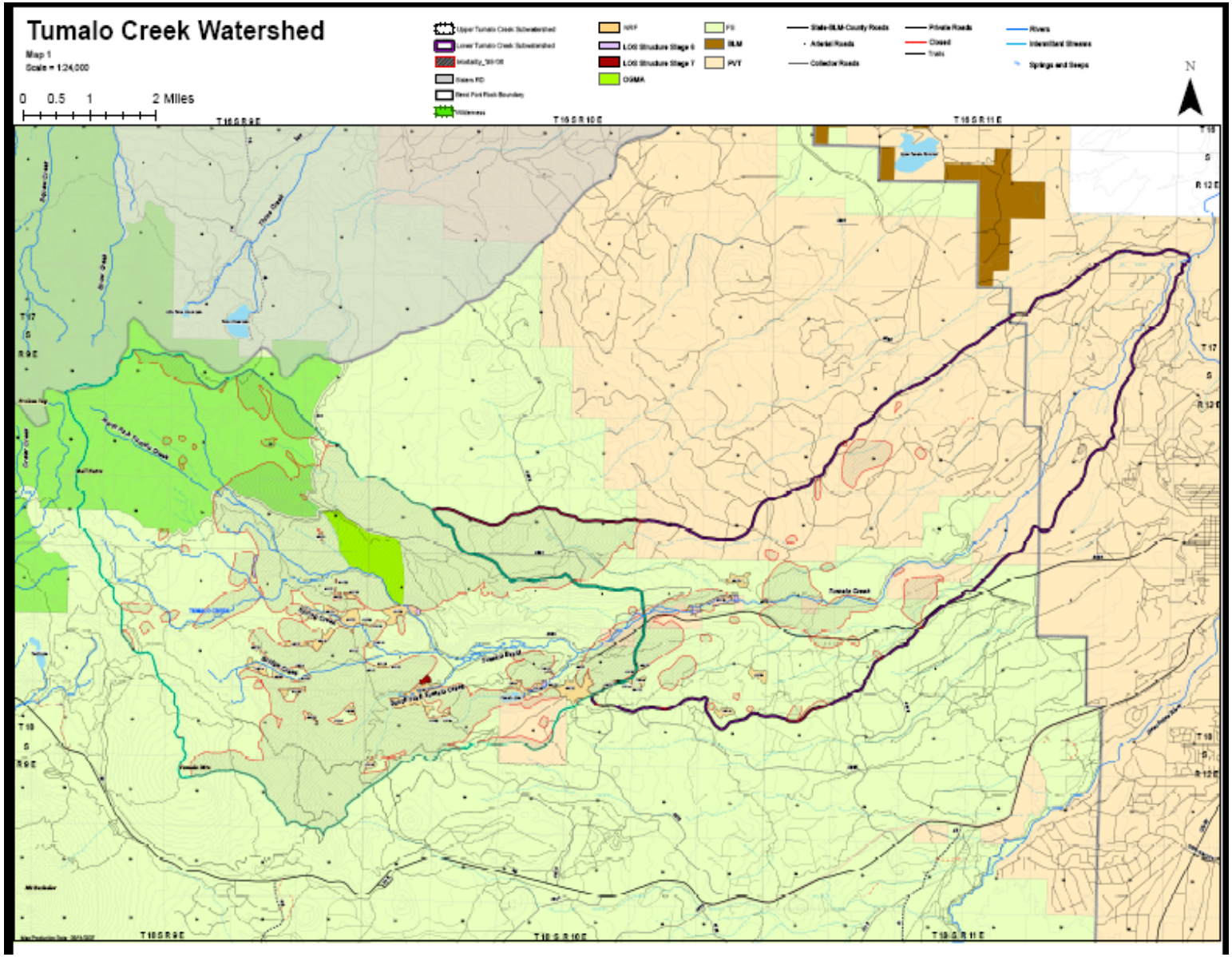


Figure 8: Bull Creek Subwatershed Insect and Disease Impact Areas



Other Insect and Disease Disturbance Factors

Western Pine Beetle: Large diameter ponderosa pine are particularly vulnerable to epidemic attacks by the western pine beetle, especially within mixed confider dry PAGs. These trees are stressed by a variety of factors, yet this can be tied to competition for scarce resources. The vulnerability of loss from epidemic levels of bark beetles is correlated to growth rates and life cycles of ponderosa pine trees. Older trees with thin crowns and slow growth rates are most likely to be attacked and killed by western pine beetle, and are typically found in highly dense stands.

Fir Engraver: The fir engraver is a bark beetle that attacks most fir species in the western United States. Most susceptible are the true fir species found within the mixed conifer dry and wet PAGs. Mass attacks occur coincident with drought conditions, and precipitation zones are key to understanding fir mortality management risk. Annual precipitation of 20 to 25 inches defines an extreme risk of white fir attacks by the fir engraver. These are typically fir trees at the lower end of their elevation range and generally conform to mixed conifer dry PAGs. In typical non-drought years, most fir engraver attacks occur in conjunction with root disease agents. Silvicultural treatments that maintain trees in a healthy, vigorous state will often minimize stand mortality risk and manage the fir engraver at endemic population levels.

Douglas Fir Beetle: The Douglas fir beetle, a large bark beetle, is similar to the mountain pine and western pine beetles in life cycle. This beetle infests trees damaged by windfall, fire or other disturbance event and attacks Douglas fir trees, particularly those found within the mixed conifer dry PAGs. Outbreaks are typically sporadic and of short duration, yet are likely to kill large numbers of trees. Damage is greatest in dense stands of mature Douglas fir trees (Eglitis 1997).

Western Spruce Budworm: Douglas fir and white fir are the tree species most at risk to western spruce budworm infestations. Conditions that favor outbreaks are large expanses of nearly pure host trees, primarily those with multi-layered canopies and host stands on warm, dry sites. Silvicultural practices that maintain trees in a healthy and vigorous condition will tend to reduce the risk to tree composition and move to more seral species also helps in minimizing the risk of epidemic budworm attacks.

Armillaria: Armillaria root disease can exist as a saprophyte on dead woody material for decades or as a lethal tree parasite. Armillaria spreads from colonized stumps or infected trees to nearby healthy trees. Tree species have varying amounts of resistance to the disease due to natural biochemistry. Resistance fades however when the tree is under stress, creating pockets of mortality, or in some cases wiping out an entire stand over time. Stress elements include overstocking, drought, and soil compaction.

Effects from armillaria are mixed. It creates canopy gaps and snags that are representative of a late-successional forest during the early phases of the disease. These conditions are considered ideal for the prey base of the spotted owl. As mortality increases in distribution and abundance, an opening is created that is no longer at a scale suitable for owl foraging. Unless resistant species are established or introduced, the opening is likely to persist for decades.

Annosus Root Disease: Annosus root disease spreads from colonized stumps from windborne spores that germinate following disturbance, typically logging. Secondary attacks by bark beetles often follow initial infections. Disease centers usually focus around old infected stumps, but also can be from wounds on live trees. Host trees are pine, mountain hemlock and true fir.

White Pine Blister Rust: This fungal disease was introduced into North America in the early 1900's from Europe with host species for white pine blister rust being the five-needled pines (includes western white pine and whitebark pine). Ribes species (gooseberry plants) are the alternate hosts for the disease, providing the mechanism for blister rust infections. This blister rust is currently infecting western white pine trees that are a minor component of stands within the mixed conifer and mountain hemlock zones of this watershed.

Dwarf Mistletoe: Dwarf mistletoe is found within the mountain hemlock, mixed conifer, lodgepole pine, and ponderosa pine types and is ubiquitous within the watershed. Native to this region, these parasites have increased in distribution and abundance as a result of fire suppression, and selective harvest practices during the past century, the distribution and intensity of mistletoe has no doubt substantially increased over time.

Heavy infections of mistletoe slow tree growth, compounding over time to the point where it may not be possible to grow stands that exhibit characteristics of large, old trees. Silvicultural treatments that are effective in reducing or controlling dwarf mistletoe include thinning, retaining mistletoe-free trees, pruning, mistletoe over story removal and species replacement.

Other Agents of Change: Several other disturbance agents of concern exist within the watershed, including Doug fir tussock moth, Pandora moth, and laminated root rot, and windstorm, but are not discussed in this section. The reader is encouraged to review the Cascade Lakes Watershed Analysis and/or the Cultus/Sheridan LSR Assessment (Deschutes National Forest, 1995/1996) for more detailed descriptions.

Landscape Area Descriptions of Current Conditions

The existing vegetation condition in this section has been summarized from aerial photo interpretation effort, using photography taken in 1995. Vegetation assignments were made, on a stand basis, for tree species, structural or developmental stage, and stand density, made on a stand basis, for tree species, structural or developmental stage, and stand density. This photo-interpreted data was used to classify the entire subwatershed area into one landscape summary, from which to describe the major conditions and trends. Similarly, reference conditions were estimated in order to establish a general picture of probable landscape conditions under native disturbance regimes, prior to European settlement (circa 1850-1910). This procedure, termed historic range of variability (HRV) analysis, was completed using a successional pathway model to establish likely reference points. For information on methods used to characterize the landscape environment, see the appropriate chapter in the appendices of this report.

Current Cover Types and Structural Stages: To establish a picture of the current condition of forested vegetation, cover type and structural stage is added to the underlying PAG foundation. The utility of this approach is for: 1) further exploration of current landscape in terms of existing species composition and structure; and 2) to establish a baseline of the most likely past structures and general composition (e.g. Historic Range of Variability of HRV estimates) to see how far the landscape has departed from an understanding of the natively-evolved landscape of the past. Note that the second item requires that a good deal of assumptions be made (See Table 8; Figure 7, page 30).

Table 8: Existing Forest Structural Stages by Plant Association Group (Percentage)

Major PAG	% of Total Landscape	Dominant Tree Species Coverage	Early Structure	Mid Structure	Late Structure
PPD/W	55%	Ponderosa Pine Dry/Wet	3%	89%	8%
MCD	15%	Mixed Conifer Dry	<1%	99%	1%
MCW	10%	Mixed Conifer Wet	20%	54%	5%
LPD/W	16%	Lodgepole Pine Dry/Wet	61%	39%	0%
MHD	4%	Mountain Hemlock Dry	0%	59%	1%
Totals	**100%**	**All Species Average**	**11%**	**82%**	**7%**

Vegetation Summary: The following discussion summarizes existing vegetation conditions.

- **Wilderness:** Fire suppression has allowed more stands to age without substantial disturbance. As a result, many more acres have advanced to late structural stages. Additionally, where meadows may have once existed, they have been encroached upon by lodgepole pine and mountain hemlock trees, in the absence of disturbance.

- **Front Country/Transition (Including Roadless):** Predominately mid-structural stages throughout, this area represents a dramatically different composition of forest vegetation than the primitive watershed conditions at the higher elevations and heavily manipulated portions on private lands at lower elevations. Eighty percent of the landscape area resides in middle-aged, medium-sized forest stands, due to a combination of factors. Previous, selective harvesting of large, old trees during the past century has reduced acreage of late and old structures stands in the ponderosa pine and mixed conifer dominated stands. Most impacts have resulted from the suppression of fire and subsequent insect epidemics of mountain pine beetle that have recycled many acres of late/old lodgepole pine stands, allowing an understory of mountain hemlock and/or white fir to flourish. It is thought that periodic fires would have replaced these stands, perhaps at an infrequent, but high intensity fire cycle. In the continued absence of fire, these hemlocks to a lesser degree true fir, stands will continue to advance successional, and a greater proportion of the landscape will grow into late/old structure, if insect and disease agents remain endemic.
- **Private:** This portion of the landscape has seen substantial change from the historic condition, as the majority of ponderosa pine acres, primarily (75%) on private lands, are in the mid structural stages at present. Timber harvest and thinning has profoundly reduced the average size and density of trees throughout this area, with virtually a 10-fold reduction in late and old forest structure, particularly in ponderosa pine stems. Continued fire suppression and harvest/thinning will continue to reduce the acreage in early forest structures, dependent upon target tree stocking densities and stand rotation lengths.
- **Dry Forest:** This area is within Deer Habitat. It consists primarily of ponderosa pine and juniper. Some vegetation management has occurred in this area. In areas of very low tree density, limited planting of ponderosa pine seedlings has occurred with mixed results of survival.

Vegetation Conditions

- **Mountain Hemlock (MHD PAG):** This PAG is found on all aspects within an elevation band of about 6,000 to 7,500 feet. Descending down slope, mountain hemlock becomes the dominant vegetation type. This type is characterized by dense stands with closed canopies of pure mountain hemlock to stands with mixes of tree species where mountain hemlock will still be the dominant or co-dominant tree. The latter stands also have dense canopies. Structurally the majority of the mountain hemlock type exhibits a range of diameters at breast height (DBH) from 9 to 21 inches are multi-sized and multi-storied. Old growth encompasses both older forest of early seral species, such as fire dependant species, and forests in later successional stages dominated by shade tolerant species.

  Mountain hemlock dominance drops away as elevation becomes lower, as it becomes less of a dominant forest type. The closed canopies of pure mountain hemlock give way to the mixtures of lodgepole pine-hemlock, and lodgepole pine-true fir. Older mountain hemlock often has heart rot which makes it a highly-desired species for wildlife.
- **Lodgepole Pine (LPD and LPW PAGs):** The lodgepole pine PAGs are located mainly within an elevation band of 5,800 to 6,800 feet with some stands located as low as 5,000 feet. This is considered high elevation lodgepole and given the natural disturbance and succession processes, the lodgepole will probably be replaced over time by mountain hemlock and/or true fir species. The majority of the lodgepole type is mapped as pure lodgepole stands and includes mixes of lodgepole and fir species within other stands. Structurally the lodgepole pine is a mix of pole size (5 to 9 inches DBH) multi-sized low density stands and pone size DBH's in single storied stands. Many of these structures appear to be of second growth vegetation characteristics and remnant stands following mountain pine beetle outbreak activity over the past few decades.
- **Mixed Conifer (MCD and MCW PAGs):** The mixed conifer has an elevation range of 4,800 to 6,800 feet with some patches found as high as 7,800 feet. The mixed conifer type becomes the dominant plant association found within this elevation zone and is composed of a mix of species

cover that includes white fir, Douglas fir, mountain hemlock and lodgepole pine. Occasionally, western white pine and, to a much less degree, western larch trees are found here. These plant associations occur both on north and south aspects and will show differences in stand densities, crown and canopy cover, and species mixtures between aspects. Ponderosa pine is found within the mixed conifer zone at the lowest elevations which are typically on slightly drier sites. At higher elevations on drier sites, ponderosa pine is a very minor component. Structurally, the mixed conifer type is composed of a mixture of small diameter to large diameter trees (5 to 21 inches DBH) and canopy covers of 25-75% percent with the majority canopy cover classes towards the low to mid percentage range. Stands are multi-sized and multi-storied with a small number of stands in the multi-sized low density class, meaning a more open stand condition. A portion of the mixed conifer stands show second growth type characteristics and about 5% of the area show more late to old growth characteristics. Old growth structures encompass both older forests of early seral species, such as fire dependent species, and forest in later successional stages dominated by shade tolerant species. The mixed conifer type fades to being the minor plant associations at the lower elevations.

- **Riparian (RIP PAGs): R**iparian zones include meadows and intermittent stream courses. The riparian area is primarily from Bear Wallow, flowing down from the roadless area through the mountain hemlock, the mixed conifer, and the ponderosa pine communities, eventually ending at Tumalo Reservoir. Bull Creek has little riparian vegetation, except near the two springs, Bear Wallow on FS lands and Bull Spring on private land.
- **Ponderosa pine (PPD and PPW PAGs):** The ponderosa pine PAGs are located at an elevation band generally below 4,800 feet. The majority of the ponderosa pine type is mapped as pure ponderosa pine stands and will include mixes of lodgepole pine and white fir species sporadically. The ponderosa pine stands are of rather uniform size (averaging 7 to 14 inches DHB) and structure (mid-structural stage). As the majority of this zone is in private industrial, forestry ownership, these are typically of high density single storied stands. Many of these structures appear to be remnant stands following commercial timber harvesting in the first half of the 20th century.

Insect and Disease (I&D) Since 1998

Since the previous analysis done in 1998, insect and disease activity has continued to increase in the analysis area (See Exhibit 10, mortality data mapped from 1998-2006). Since 1998, insect and disease activity has affected approximately 21% of the total acres (12,293 acres), 36% overall. An obvious cause for the higher percentage of insect and disease activity in the western portion of the subwatershed is that fewer density management activities have occurred in this higher elevation, more inaccessible area. The wilderness and un-roaded areas have not had stand density reduced through management activities. With the increased stress on the trees caused by drier conditions in the past decade, these denser, older structural stage stands are also more susceptible to insect and disease caused mortality. All PAGS are at continued risk of insect and disease caused mortality; mortality is heaviest in the MCW and LPD/W PAGs. ***Note:*** *A minimum of only 1 tree per 4acres triggers the determination that an area has been affected by insects and disease.*

Stand Density Classes:

Stand density has also been classified for the landscape, although there is currently no readily available method to reference existing conditions to the historic. In the absence of fire disturbance, stands gained higher densities in many areas but densities have been substantially reduced by the mountain pine beetle.

Landscape Patterns and Patches

Meadow and rock areas are easily identified patches within the sub-watershed. Most meadows are located within the higher elevations along the fringe between the sparsely vegetated and mountain hemlock areas. Rock areas occur mainly at the highest elevations and are a pronounced geological feature.

Definitive vegetation landscape patterns and patches are somewhat difficult to define within the sub-watershed. Infrequent native fire regimes have allowed for much of the vegetation types to begin development of old growth structural characteristics. This is especially so for undisturbed portions of the watersheds above 6,000 feet elevation. Patch patterns are minimal except for changes in vegetation structure and changes in canopy densities due to past defoliator pests. Widespread mountain pine beetle activity has created extensive areas of early structural stages.

Endemic levels of defoliators and bark beetle generally create little noticed changes. However, at the widespread mountain pine beetle levels of the past 10 years these insects occur in epidemic proportions and major mortality has occurred to create open areas. Mortality from bark beetles has been substantial within the lodgepole pine, both to the west of Forest Road 4602 in the roadless area and to the east of Forest Road 4602 where management can occur in a more substantial manner

FIRE/FUELS

HISTORIC CONDITION

Evidence since the cessation of volcanic activity in the area suggests significant interactions between climate, vegetation, and fire that continued into present times. Pollen analyses conducted in the western Cascades (Leopold et al. 1982) imply a dynamic relationship between vegetation and fire due to a much warmer and drier climate. This indicates that the range of dry meadows and shrub/grass plant associations were much more extensive and large range fires were very frequent.

There are historical accounts of aboriginal peoples using fire in the Deschutes River Basin for hunting to improve seed and berry crops, and as a weapon of war (Stewart 1936). Paiute, Klamath, and Modoc were frequent visitors and used fire for the same reasons. The first people of European descent to appear occurred about 1825. In the early 1840s immigrants passed through attempting to find shorter routes to the Willamette Valley (Bork, 1984). Settlers often used fire to clear land for livestock and crops (Pyne, 1982; Shinn, 1978).

CURRENT CONDITION

In the subwatershed, there are a variety of vegetation types and fire regimes representing the effects of the historically repetitious fire with variable spread rates and intensities. Fire occurrence data from 1980 to 2008 revealed 71 fire starts. Most of these fires were ignited by lightning. The area could still be accurately described as a "fire environment" with an increasing human component. The Greater Bend Community Wildfire Protection Plan (CWPP) and The East & West Deschutes County CWPP were developed in response to the fire environment concerns.

The area has been, and continues to be, impacted by mountain pine beetle activity, with heavy lodgepole pine mortality. The fuel loading when the dead trees fall is not acceptable for many values (ecological, social, etc.). Most lodgepole pine trees fall over within fourteen years after dying (Mitchell 1998). Current data suggest that fuels would increase from 1 to 85 tons per acre once these snags fall. The optimum range of CWM for cool lodgepole pine is described as 8 to 24 tons per acre (Brown 2003).

The analysis of the watershed suggests that the potential for extreme fire behavior associated with current and future fuel accumulations is high, with public concern and awareness of this potential also increasing. The possibility of a stand replacement fire escaping this area exists, becoming more likely if current conditions are not mitigated. Some key issues affecting fuels management are airshed restrictions, increased pressure of an expanding WUI, and limited access into the area.

Poor access up Forest Road 4601 (currently being reconstructed) and a lack of attractions such as waater and scenic views contribute to low public use. The assessment area has a large Roadless designation bordered by the Three Sisters Wilderness to the west. There is a band of Forest Service managed lands between the roadless and private timberland to the east. Until the most recent mountain pine beetle

epidemic, concurrent with the expanding population of the local community, there was little compelling reason to take a hard look at management in the area. For those reasons, there has been minimal to no surveys or data collection to date. Much of the information needed to make sound management decisions still need to be gathered.

FIRE ECOLOGY

Mountain hemlock/alpine zones: Large fires are relatively infrequent in these high elevations sites but lightning patterns and frequency show that ignitions are common. Fire intensity is dependent upon weather and development of fuel complexes capable of supporting crown fire. These heavy fuel complexes take a long time to develop and are usually small. High intensity fires are infrequent and usually less than 50 acres. Low intensity fires are more frequent but rarely exceed 100 acres.

Mixed conifer zone: Fire frequency on these sites ranges from about 10 to 50 years. White fir (*Abies concolor)* forests in Crater Lake National Park were found to have a return frequency of 9 to 42 years by McNeil and Zobel (1980). This would indicate fire of low intensity due to the frequency. The extent of these fires was not great. At Crater Lake, McNeil and Zobel found few fires that burned their entire study areas of 7.5 square kilometers. According to Bork (1984), there are no existing trees scarred by fire across a 125-hectare area at Pringle Falls.

Moist lodgepole pine zone: Fire in these stands characteristically burned with low to moderate intensities occasionally torching out in crowns. The fire behavior is dependent upon stand condition and climate. Patchy fuel continuity prevented disturbance at a landscape scale (Hopkins, 1994).

Dry lodgepole pine zone: These stands are visited by fire every 40 to 60 years. Fire intensity ranges from slow burning, smoldering duff and litter to crown fire. Crown fires are the most common due to low natural fuel loads. A fire in any stand will cause mortality, primarily lodgepole pine. An important related disturbance is mountain pine beetle (*Dendroctonus ponderosae*) attacks in stagnant or low vigor stands. These attacks can cause a high incidence of tree mortality and create heavy loads of down and dead material intermixed with developing regeneration. In the absence of fire, this insect may provide the disturbance that seems to be a natural part of stand development over time.

Ponderosa pine zone: The expansive stands of ponderosa pine that once dominated much of the area were a result of low to moderate intensity fires frequenting the stands every 7 to 30 years (Bork, 1984). Stand replacement events were rare but occurred in 80 to 300 year intervals, leaving patches of replacement regeneration. These patches varied in size from 10 to 100 acres (Hopkins, 1994).

FIRE REGIMES

Fire Regimes is an ecological index that measures the fire return intervals and fire severity. Changes in forest structure have occurred since Euro-American settlement due to multiple factors, including fire exclusion, grazing and timber management. In many cases, the changes in forest structure have led to changes in fire behavior resulting in increased fire risk to communities, as well as a decline in or loss of fire-adapted plant and animal species.

The Bull Creek subwatershed has all five fire regimes (Table 9) and has areas of non-vegetated areas and agricultural lands. Most of Fire Regimes I and II and all agricultural lands do not land within Forest Service jurisdiction.

Table 9: Fire Regimes

Fire Regime	Within watershed		FS lands	
	Acres	Percent	Acres	Percent
Non-vegetated or agricultural land	4,126	12.9	6	0.1
I – ponderosa pine, 0 – 35 year frequency, low to mixed severity	20,880	65.0	1939	26.9
II – grass/shrub 0 – 35 year frequency, low to mixed severity	1,132	3.5	45	0.1

Fire Regime	Within watershed		FS lands	
	Acres	Percent	Acres	Percent
III – mixed conifer 35 – 100+ year frequency, mixed severity	4,335	13.5	3,554	49.4
IV – lodgepole pine 35 – 100+ year frequency, high severity	828	2.5	828	11.6
V – mountain hemlock/subalpine 200+ year frequency, high severity	852	2.6	852	11.9
Totals	**32,153**	**100**	**7,224**	**100**

LARGE FIRES WITHIN THE WATERSHED

In recent history, there haven't been any large fires within the subwatershed. There have been large fires nearby: including Delicious, Awbry Hall, and Bridge Creek Fires that burned in the last 40 years.

The nearest fire was the 1979 Bridge Creek Fire (3,364 acres), a human caused fire which burned most of the vegetation within its boundaries. This fire has minimal mosaic patches, which are scattered only along a small portion of the fire boundaries. The intensity of the fire may have contributed to the short-term hydrophobic character of the pumice soil in some areas. Structures were placed on slopes following the fire to reduce downhill flow velocities and sedimentation rates into Tumalo and Bridge Creeks. Although some of the south aspect slopes have been vegetated enough to be considered relatively stable.

A potential risk exists for a similar event given the right combination of weather patterns and fuel conditions. Although the probability is low due to the right conditions occurring on only 6 days throughout the summer, these conditions would still require monitoring during the entire year.

Figure 9: Bull Creek Subwatershed Fire Regimes

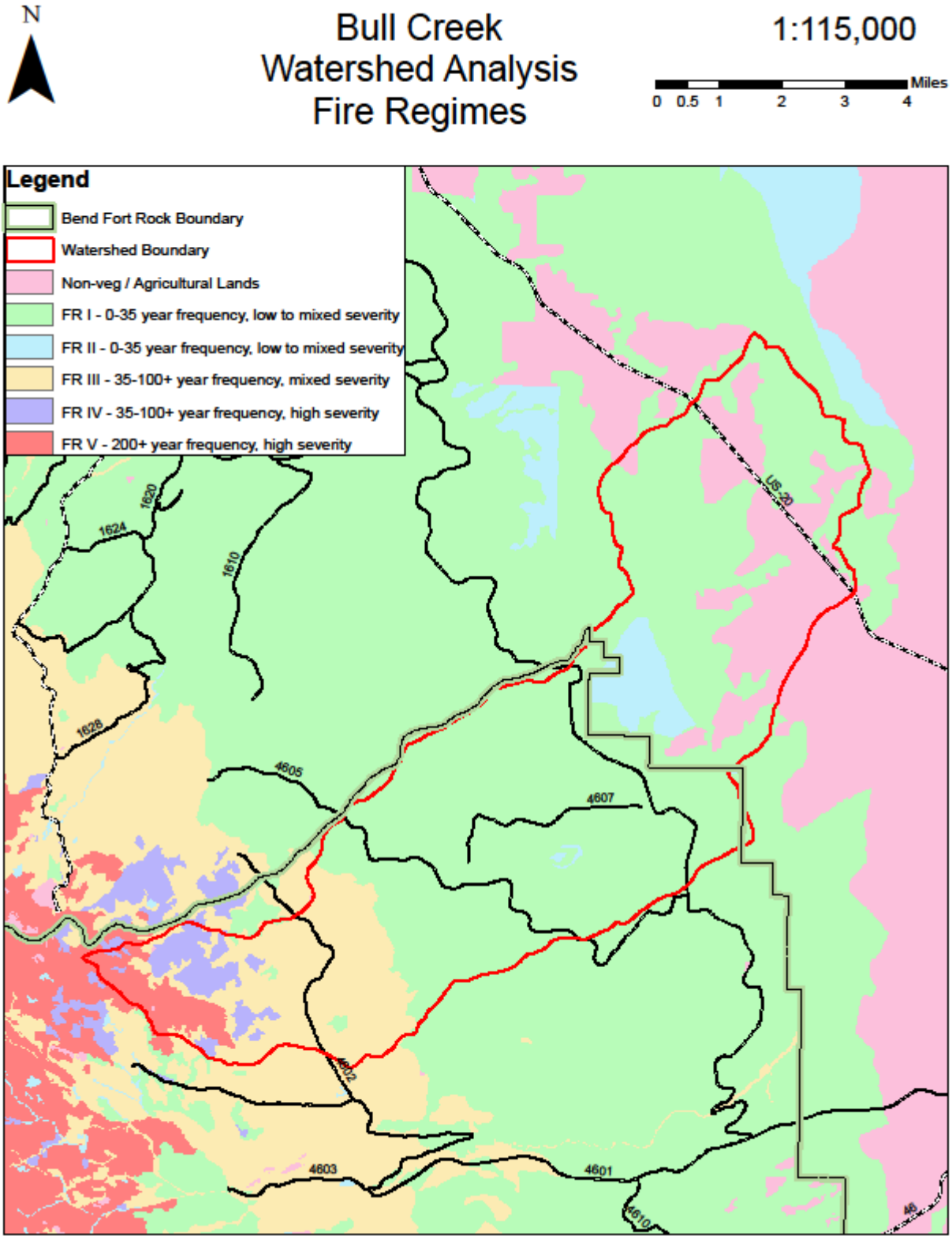
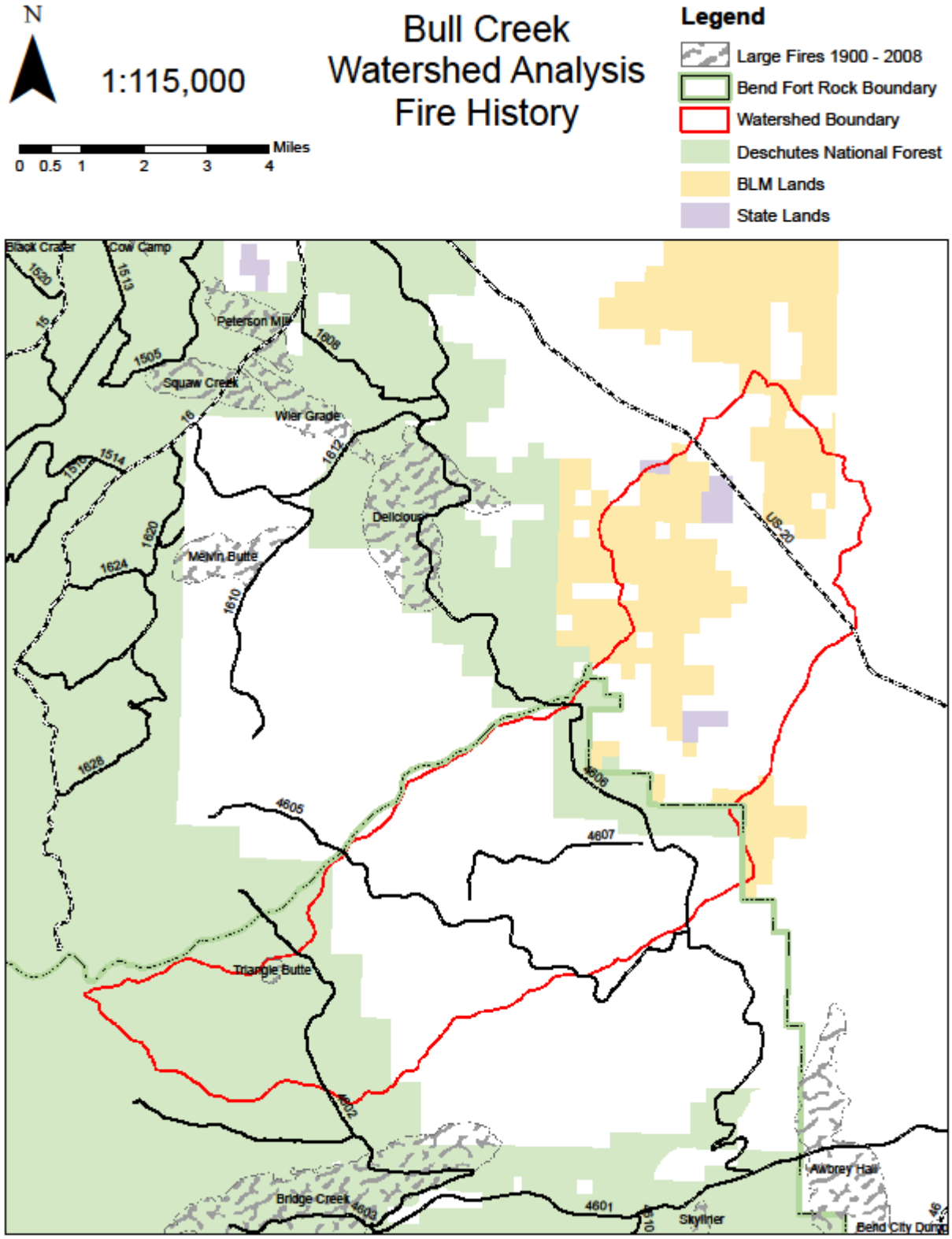


Figure 10: Bull Creek Subwatershed Large Fire History



FUEL HAZARD AND POTENTIAL FIRE BEHAVIOR

This report describes the analysis conducted to address potential fire behavior and hazardous fuel conditions within the Bull Creek Watershed. Data used to characterize the landscape were developed for the Deschutes National Forest based on 2004 satellite imagery.

Conditions were modeled for a "problem fire," defined here for the Bull Creek Watershed as a fire driven by a northwesterly wind and threatening the Bend Municipal Watershed and the wildland-urban interface. For modeling purposes, problem fire conditions are:

Wind direction: 315 degrees
Wind Speed: 14 mph (20-foot wind)
Fuel Moistures (97% percentile): 1 hr: 6%, 10 hr: 7%, 100 hr: 10%,
Live Woody: 70%, Live Herbaceous: 30%

A northwest wind (315 degrees) at speeds of 14 mph would be a relatively rare event; however, it represents the condition that is the greatest threat to values at risk. At wind speeds of 5 mph, spotting distance is 0.25 miles and increase to 0.75 miles at 14 mph.

Table 10 displays acres by fuel model for the Bull Creek Watershed. Each fuel model also has the fire behavior associated with it at 97th percentile weather and predicted flame lengths. Fires with flame lengths less than four feet, hand crews can control the fire directly. A fire with flame lengths between four and eight feet requires heavy equipment to control the fire directly and hand crews must do it indirectly. Fires with flame lengths greater than eight feet require the use of aerial resources and all ground resources must fight the fire indirectly.

Currently, the majority of the area within the Bull Creek Watershed has fuel models that burn with high/extreme fire behavior, as shown in Table 11 and Figure 11. If a fire should get started, under 97th percentile weather, and isn't controlled by initial attack resources, it would be difficult to control the fire without beneficial changes in weather.

Most of the watershed does not have a high enough crown density to maintain a crown fire. There would be small areas of crown fire activity but it would mostly be an independent tree, or clumps trees torching. This is shown in Figure 12

Table 10: Fuel Models, Fire Behavior, and Flame Lengths

Fuel Model	Acres	Watershed (%)	Fire Behavior	Flame Length (Feet)
1 – Grass, short	22	0.1	Moderate	7.5 ft
2 – Grass, shrub, litter	1,874	5.8	High/Extreme	11.8 ft
3 – Grass, tall	1,273	4.0	High/Extreme	13.4 ft
6 - Shrub	18,199	56.6	High/Extreme	10.0 ft
8 – Short-needle litter	4,847	15.1	Low	1.8 ft
9 – Long-needle litter	2,619	8.1	Moderate	5.2 ft
10 – Heavy dead & down	1,818	5.7	High/Extreme	9.2 ft
11 – Logging slash - light	466	1.4	Low	3.5 ft
Non-vegetated	1,035	3.2	N / A	
Total	**32,153**	**100**		

Table 11: Fire Behavior Distribution Across Bull Creek Subwatershed

Fire Behavior	Acres	Percent of Watershed
Low	5,313	16.5
Moderate	2,641	8.2
High/Extreme	23,164	72.1
Non-vegetated	1,035	3.2

Figure 11: Bull Creek Subwatershed Fire Behavior

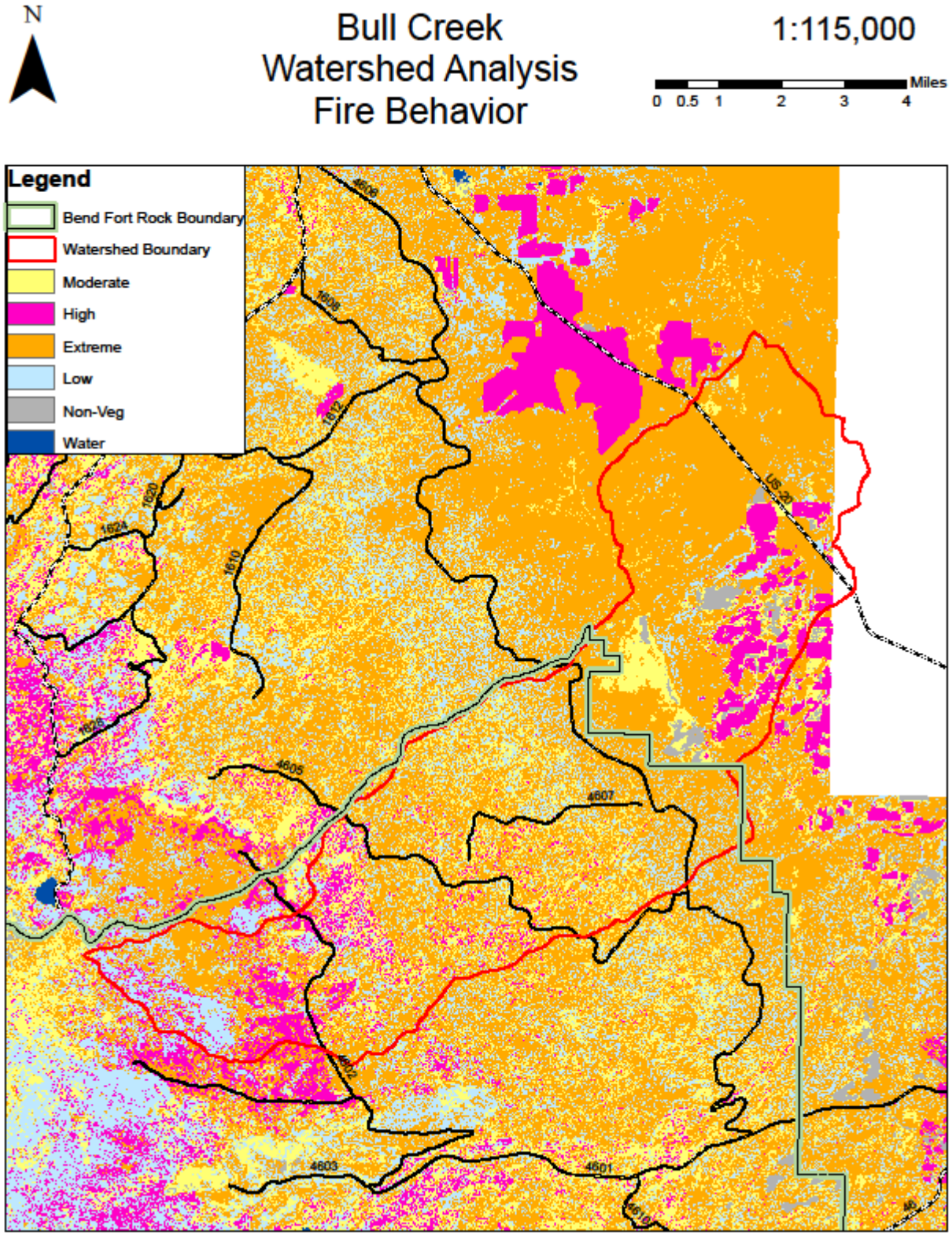
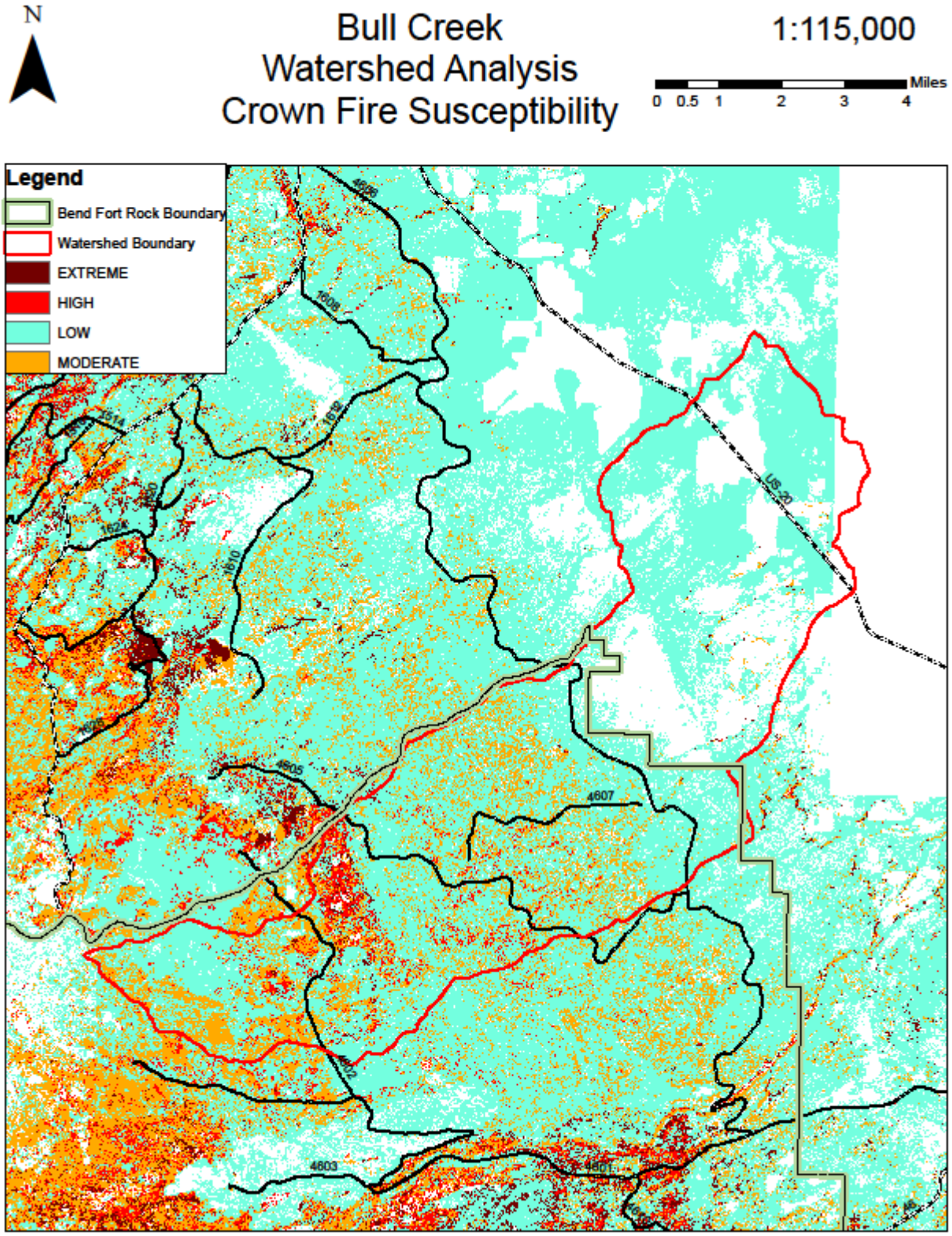


Figure 12: Bull Creek Subwatershed Crown Fire Susceptibility



FISHERIES

WATER RESOURCE

The Bull Creek sub-watershed lacks surface water, despite moderate to high levels of precipitation at the higher elevations (40-60 inches annually). The highly permeable volcanic surface soils accounts for substantial groundwater recharge flowing northeasterly from the high elevations on the western portion of the sub-watershed, possibly emerging as spring water near Lake Billy Chinook. Surface water resources are limited to a few small springs, shallow ponds, seeps, Tumalo Reservoir (private land), and intermittent and ephemeral channels. Riparian vegetation associated with these areas is sparse and of narrow width.

Table 12: Acres of Riparian Habitat Conservation Areas, Riparian Reserves, and Stream Miles within the Bull Creek Subwatershed

Waterbody Type	RHCA/RR acres (all ownerships)	RHCA/RR Acres (Deschutes NF)	Stream miles (all ownerships)	Stream miles (Deschutes NF)
Ponds, reservoirs	151	7	N/A	N/A
Buffer for ponds, reservoirs	97	53	N/A	N/A
Class 4 (intermittent / ephemeral channels)	377	97	23.9	4.4
Wetland and buffer	6	6	N/A	N/A
Total RHCA/RR acres	**631**	**163**	**23.9**	**4.4**

On national forest lands, lentic systems are limited to 4 small, shallow ponds that may or may not hold water seasonally depending on climate. There is little available information on these ponds and more field investigation is needed. Two small springs are located within the sub-watershed, Bearwallows and Bull Spring. Only Bearwallows is located on forest lands. Discharge information on these springs is unknown. Bull Creek, for which the sub-watershed draws its name, is an intermittent stream that is fed at times by discharge from Bearwallows spring. Riparian vegetation associated with these springs and intermittent/ephemeral channels is sparse.

Reference conditions were likely very similar to current conditions, the major difference being the creation of Tumalo Reservoir and associated irrigation ditches on private land.

AQUATIC SPECIES

Current and Reference Conditions

Current and Reference conditions are similar. There are no records of native fish populations within the Bull Creek sub-watershed, due to the lack of available habitat. Non-native three-spined sticklebacks inhabit Tumalo Reservoir, gaining access from lower Tumalo Creek through the Tumalo Feed Canal. There is no information available on aquatic invertebrates.

AQUATIC CONSERVATION STRATEGY

The Northwest Forest Plan provides guidelines for developing an Aquatic Conservation Strategy for the purpose of protecting and restoring aquatic/riparian ecosystems on Forest Service administered lands within the eastern extent of the range of the northern spotted owl. The main objectives are to ensure protection of aquatic systems, maintain connectivity, water quality, and water and sediment storage and transport regimes, and maintain and restore fish, wildlife, and plant populations and diversity. In order to meet the Aquatic Conversation Strategy objectives, a proposed project or management action must maintain the existing condition or move it within the range of natural variability of the important physical, social, and biological components of the watershed.

Riparian Reserves

The key components of the Aquatic Conversation Strategy are Riparian Reserves (RRs), Key Watersheds, Watershed Analysis, and Watershed Restoration. Riparian Reserves are portions of watersheds where riparian-dependent resources receive primary emphasis and include water bodies such as lakes and ponds, wetlands, streams, stream processes, and fish habitats. The Bull Creek sub-watershed is not a Key Watershed.

Riparian Habitat Conservation Areas

Most of the sub-watershed lies east of the northern spotted owl line and therefore falls under the Inland Native Fish Strategy (INFISH) Environmental Assessment (1995). Rather than RRs, INFISH defines riparian areas and associated lands as Riparian Habitat Conservation Areas (RHCAs). As with RRs, riparian-dependent resources receive primary emphasis. With a few exceptions, the widths for RHCAs mimic those of RRs from the NWFP. For the Bull Creek sub-watershed, standard widths for Riparian Reserves and RHCAs have been adopted as described in the Record of Decisions for the NWFP and INFISH, respectively. RR and RHCA widths are described below:

Permanently flowing, non-fish-bearing stream:

RRs and RHCAs consist of the stream and the area on each side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100 year floodplain, or to the outer edges of riparian vegetation, or to a distance equal to the height of one site potential tree, or 150 feet slope distance (300 feet total, including both sides of the stream channel), whichever is greatest.

Wetlands greater than one acre:

RRs and RHCAs consist of wetlands and the area to the outer edges of the riparian vegetation or to the extent of seasonally saturated soil, or to the extent of unstable and potentially unstable areas, or to a distance equal to the height of one site-potential tree, or 150 feet slope distance from the edge of wetlands greater than 1 acres, whichever is greatest. Site specific analysis will be needed to determine the greatest slope distance for wetlands greater than one acre within the Bull Creek Subwatershed.

Intermittent streams (Seasonally flowing) and wetlands less than one acre:

Intermittent streams are defined as any nonpermanent flowing drainage feature having a definable channel and evidence of annual scour or deposition.

Seasonally flowing or intermittent streams, wetlands less than 1 acre, and unstable and potentially unstable areas - This category applies to streams with high variability in size and site-specific characteristics. At a minimum, the RRs and RHCAs must include:

- The extent of unstable and potentially unstable areas (including earthflows),
- The stream channel and extend to the top of the gorge,
- The stream channel or wetland and the area from the edges of the stream channel or wetland to the outer edges of the riparian vegetation, and
- Extension from the edges of the stream channel to a distance equal to the height of one site-potential tree, or 100 feet slope distance, whichever is greatest (RRs)
- For RHCAs, the area from the edges of the stream channel, wetland, landlside, or landlside-prone area to a distance equal to the height of one-half site potential tree, or 50 feet slope distance, whichever is greatest.

TERRESTRIAL WILDLIFE SPECIES

HISTORIC AND CURRENT CONDITIONS

Wilderness and Cold Forest/ Unroaded

The wilderness and unroaded areas provide contiguous habitats mainly by natural disturbances (insect outbreaks, fire, etc.). Habitats within these landscape areas are similar to historic conditions, with the exception of increased stand density, increase in LOS acres and a lack of small openings, all of which have resulted from fire suppression. The most prominent change in direct human interaction in this portion of the watershed is the increase in recreational use. Although use many be considered light in relation to other areas of the District, the level of human activity may be significant enough o displace some species, such as wolverine, that avoid any type of human presence.

Front Country/Transition

This zone represents the middle elevations between the intensively managed Landscape Zone C and the relatively unmanaged, primitive Landscape Zone A. Here, forested vegetation is a mixture of mountain hemlock, lodgepole pine, and mixed conifer stands. Forest structure is predominately mid-structural stage (51%), with 19% of the Zone in early, and 30% in late and old structure. Historically, there was probably much less mountain hemlock represented with more of an equitable distribution of structural stage percentages. Fragmentation is low to moderate throughout most of the zone (and may be lower than what occurred historically) with Bridge Creek Fire and scattered timber harvest units accounting for most breaks in forested continuity. Road densities are higher than Zone A, but still much lower than Zone C. Recreation activity is moderate to high and includes such activities as hunting, fishing, mountain biking, cross country skiing, and snowmobiling.

Private/Dry Forest and Dry Forest

The lower elevations of the watershed consist primarily of ponderosa pine wet and dry communities, with less amounts of mixed conifer, lodgepole pine, and juniper stands. Historically this area was dominated by ponderosa pine, the majority of which (80%) was in late and old structural condition with understory species and densities governed by low intensity, short return fire intervals. Tree spacing was variable, with most mature stems being in small (1/2 to 2 acres) clumps. Under the current condition, a vast majority of acres (62%) are mid-structure with little variation in stem spacing. Road densities are highest in this portion of the watershed, with densities exceeding 5 miles per square mile. Recreation intensity is light to moderate. Much of this zone consists of mule deer winter range.

FEDERAL THREATENED, ENDANGERED, AND CANDIDATE SPECIES

Wildlife species represented in this assessment include those given federal status (threatened, endangered, sensitive, proposed and candidate species) that are known to inhabit or potentially inhabit the watershed. Also included are selected species with special status that are also known to occur or have the potential to occur within the watershed. These are management indicator species (MIS) as designated in the Deschutes National Forest Land and Resource Management Plan, and species characterized as Birds of Conservation Concern (BCC) by the U.S. Fish and Wildlife Service, and Landbird Focal Species from the Conservation Strategy for Landbirds of the East-Slope of the Cascades.

Northern Spotted Owl

Spotted owls generally require mature or old-growth coniferous forest with complex structure including multiple canopy layers, large green trees and snags, heavy canopy habitat, and coarse woody material on the floor. Functional nesting, roosting, and foraging (NRF) habitat occurs in multi-storied canopies in mixed conifer stands and in riparian areas. The canopy cover is typically greater than or equal to 40% with an overstory comprised of at least five percent of trees greater than 21 inches diameter breast height

(dbh). Habitat that meets nesting and roosting requirements also provides foraging habitat, although a wider array of forest types are used for foraging, including more open and fragmented habitat.

Dispersal habitat is important for spotted owls to move from one territory to another, find food, and for young to move away from natal areas. Poor dispersal habitat puts the young and adults at risk of predation and reduces their ability to secure prey. Maintaining and enhancing dispersal habitat is critical to increasing the number of breeding pairs and recovery of the species. Dispersal habitat is defined as a minimum of 30% canopy closure and minimum average dbh of 11 inches for mountain hemlock, ponderosa pine, and mixed conifer dry PAGs and 7 inches dbh for lodgepole pine PAGs. In mixed conifer wet and riparian PAGs, a minimum of 40% canopy closure can often be met. North-south connectivity is primarily along the western third of the watershed in wilderness areas. NRF habitat that no longer supports suitable NRF functions should be managed to provide dispersal habitat and north-south connectivity to the extent possible.

Historical Condition

Historic distribution of spotted owls in the Bull Creek subwatershed is not known but habitat would have included stands in the mixed conifer PAGs for nesting, roosting, and foraging (NRF). There are 149 acres of ground-truthed NRF habitat in the watershed, all within the LRMP Front country Seen allocation in mixed conifer wet PAG. Surveys were conducted in the subwatershed in 2010 and 2011. No spotted owls were detected. Three night surveys were conducted in the watershed for the spotted owl in 2009 near the Triangle Hill area, north of the Bull Creek subwatershed, with no detections. Protocol surveys were conducted in the Tumalo Creek Watershed immediately to the south in 2007 and 2008, with a detection of a pair during a night survey in 2008 west of Tumalo Creek. No nest or activity center for this pair was located during daytime follow-up surveys. The closest known spotted owl pairs are Snow Creek, 7 miles to the northwest on the Sisters RD and a resident single on Sheridan Mountain, 12 miles to the south on the Bend-Ft. Rock RD. Maintaining dispersal habitat in the Bull Creek subwatershed will provide connectivity between these home ranges, enabling owls to move across the landscape and potentially establish new territories.

Dispersal and north-south connectivity habitat would likely have been greater historically due to increased canopy cover prior to insects and disease in the mixed conifer wet and dry, lodgepole pine, and mountain hemlock PAGs..

Trends and Interpretation:

Across its range, this species is still at substantial risk of decline. Threats from the barred owl and large-scale fires are expected to increase, absent active management. Retention of roadless and wilderness areas will aid in maintaining some viable habitat. Proposed projects and activities in the watershed that could affect spotted owls include vegetation management, large-scale fire, danger tree removal, firewood and fuelwood collection, and recreational disturbance. Maintaining dispersal habitat/connectivity through this watershed between the Sisters and Bend-Ft. Rock Ranger Districts is of high importance. Stands that no longer function as NRF habitat in the future should be managed to provide for dispersal/connectivity habitat

Pacific Fisher

Pacific fishers usually den in stands with more than 80% canopy closure, more than 16 snags per acre, and 67 logs at least 21" dbh per acre (Aubrey and Raley 2006) in mixed conifer habitats. Denning and rest sites occur in large live trees (mostly Douglas-fir) with mistletoe brooms, limb clumping, rodent nests, or some other tree deformity. Complex physical structure close to the ground is important for providing prey habitat. They have large territories (minimum of 2,500 acres) and long-distance movements.

Historic and Current Conditions:

Prior to 1970, fishers were documented on the Bend-Ft. Rock RD in the Three Sisters area, Mt Bachelor, Elk and Hosmer Lakes, and west of little Cultus Lake (Deibert et al. 1970). In western and central Oregon, two disjunct populations currently exist: one in the northern Siskiyous and one in the southern Oregon Cascade Range. Winter surveys from 1997 to 1999 using Trailmaster baited cameras were conducted along the Sisters wilderness boundary northwest of the watershed. No fishers were detected. In 2005, an unconfirmed sighting of an immature fisher was reported in the Wickiup Reservoir area on the Bend-Ft. Rock Ranger district, approximately 30 miles to the south of the Bull Creek watershed. It is highly unlikely that fishers currently inhabit the watershed; however, suitable denning habitat occurs in the mixed conifer wet and mountain hemlock wet and dry PAGs in the IRA and wilderness areas. Historically, the watershed would have provided greater canopy cover prior to insects and disease. However, fire suppression may have created more dense conditions in some areas due to fir encroachment.

Trends and Interpretation:

The fisher is considered imperiled in the state of Oregon (NatureServe 2011), primarily due to habitat loss and fragmentation from previous logging/vegetation management activities. Other potential impacts include high road densities, vehicle collisions, snowmobiling, loss of habitat to large-scale fire, hazardous tree removal, firewood and fuelwood collection, and recreational disturbance. LOS stands in mixed conifer wet and mountain hemlock wet and dry PAGs areas have the highest potential for fisher occupancy.

California Wolverine

Wolverines inhabit high-elevation lodgepole pine and mixed conifer habitats with high canopy closure. They have very large home ranges, ranging from 60 mi2 to for females to over 540 mi2 for males; therefore, they naturally occur at low densities (Aubrey et al. 2007).

Historic and Current Conditions:

In Central Oregon, historic observations include Three-Fingered Jack (1970), Broken Top (1969), Many Lakes Basin (1972), and the outflow at Suttle Lake (1973). The last verifiable and documented wolverine sighting in Central Oregon was in 1992 (Aubrey et al. 2007). Aubrey et al. (2007) suggested a low likelihood of wolverines in the Central Cascades due to the fragmented nature of suitable habitat and the large distance between the Central Cascades and suitable mountain ranges in eastern Oregon and Washington.

Trends and Interpretation

Wolverine populations were drastically reduced throughout their range by trapping during the first half of the 20th century, and have been extirpated from much of their former range. Increased recreation use within the watershed and surrounding areas, especially winter recreation, pose a threat to wolverine movement and distribution. Recent sightings around Broken Top, Tam McArthur Rim, Benchmark Butte, Crane Prairie, and Cultus Lake indicate a moderate to high probability that wolverine inhabit the watershed, at least in a transitory fashion. Helicopter surveys for den sites were conducted during the winter of 1998 by the Oregon Department of Fish and Wildlife in wilderness areas on the Forest. These surveys did not result in any sightings. The Bearwallows IRA and wilderness area have the highest potential for wolverine habitat due to the reduced human access. However, wolverines are highly mobile and given the linear nature of the high altitude habitat on the Deschutes and the road density, it is likely that any wolverines inhabiting the watershed would travel or disperse across roads and near recreation areas outside of the IRA and wilderness. Vegetation management activities, backcountry skiing, snowmobiling, and roads may negatively impact wolverines (Ruggiero et al. 2007).n.

Gray wolf

In Oregon, the gray wolf is listed as Federally Endangered in areas west of Highways 395, 78 and 95 which includes the Forest. A single male gray wolf was documented dispersing through the Forest in 2011 and subsequently traveled south into California. Wolves occur in a wide variety of forested and desert habitats and could potentially disperse through in the Bull Creek subwatershed. They prefer forested habitats with some open areas such as river valleys and meadows for hunting prey including deer and elk. Wolf packs (5-15 animals) can have very large territories up to 400 square miles or larger.

Historic and Current Conditions

Historic and current habitat conditions are roughly similar for the gray wolf, although denser forests in some areas due to fire suppression and increased recreational use have likely degraded the habitat somewhat in some portions of the watershed. The Bearwallows IRA and wilderness areas would provide the best habitat with the least disturbance from recreational uses. Historically, human use in the watershed would have been very low compared with current conditions.

Trends and Interpretation

Vegetation treatments and prescribed fire that emphasized LOS structure would improve stand conditions for the gray wolf long-term by opening up previously dense areas of the forest. Increased recreational use and development of the private lands in the watershed could deter wolves from inhabiting the watershed.

REGIONAL FORESTER SENSITIVE SPECIES

Lewis's Woodpecker

Habitat for the Lewis's woodpecker includes old-forest, single-storied ponderosa pine and cottonwoods (to a lesser degree). They require large snags in an advanced state of decay that are easy to excavate, or they use old cavities created by other woodpeckers. Nest trees generally average 17-44 inches dbh (Saab and Dudley 1998, Wisdom et al. 2000). Burned ponderosa pine forests created by stand-replacing fires provide highly productive habitats as compared to unburned pine (Wisdom et al. 2000).

Historic and Current Conditions

Historic and current presence of Lewis's woodpecker in the watershed is not known due to a lack of surveys. Where large diameter ponderosa pine still exists at lower elevations, fire suppression has led to understory intrusions by multiple tree species which results in unsuitable habitat conditions for Lewis' woodpeckers.

Trends and Interpretation

Vegetation management activities that move ponderosa pine stands toward LOS would benefit this species. Areas of late structure habitat are at risk for catastrophic fire, which could be a potential benefit for Lewis' woodpecker. The Lewis's woodpecker is identified in the Conservation Strategy for Landbirds of the East-Slope of the Cascades Mountains in Oregon and Washington (Conservation Strategy) as a focal species for ponderosa pine forests with patches of burned old forest (Altman 2000.

White-Headed Woodpecker

The white-headed woodpecker prefers both live and dead large-diameter ponderosa pines with approximately 40% canopy cover (Marshall 1997). They are usually absent from early seral ponderosa pine stands.

Historic and Current Conditions

Documented provincial declines in numbers indicate historic populations in the region to be greater than under the current condition. Historically, LOS ponderosa pine habitat suitable for this species had a wide distribution prior to timber harvest activities in the 1940s. Presence in the watershed is unknown due to a

lack of surveys. The large decrease in LOS pine has greatly reduced areas of habitat suitable for this species across the region. Where large diameter ponderosa pine still exists at lower elevations, fire suppression has led to understory intrusions by multiple tree species that essentially create unsuitable conditions for the white-headed woodpeckers.

Trends and Interpretation

The white-headed woodpecker is identified in the Conservation Strategy as a landbird focal species of large patches of old ponderosa pine forest with large snags (Altman 2000). Conservation issues include loss of large diameter ponderosa pine trees from timber harvest, grazing, and understory fir encroachment from previous fire suppression, and habitat fragmentation. The proposed management of the Fidelity lands under private ownership to enhance growth of large ponderosa pine would improve habitat for this species. Vegetation management activities that move ponderosa pine stands toward LOS would benefit this species. Stands at risk to insect and disease and large-scale fire pose a risk for loss of white-headed woodpecker habitat.

Silver-Bordered Fritillary

This butterfly species inhabits wet meadows, bogs, and marshes, forest openings in mountainous areas, and spring-fed meadows in dry prairies. Bearwallows spring on Forest land and Bull Springs on private land are potential habitat for this species in the watershed.

Historic and Current Conditions

Historic and current occurrence is not known. Current conditions may be reduced from historic due to encroachment in wet meadows from fire suppression.

Trends and Interpretation

This species is declining across the region. Threats to this species include livestock overgrazing, wetland loss, and woody vegetation encroachment of willows and hawthorns from wildfire suppression (Miller and Hammond 2007). Two primary colonies exist in Oregon: one at Big Summit Prairie on the Ochoco National Forest and one in the Strawberry Mountains on the Malheur National Forest (Miller and Hammond 2007). It has not been documented on the Forest; however, no surveys have been conducted for it

Johnson's Hairstreak

This hairstreak is dependent on dwarf mistletoes (genus Arceuthobium) and other mistletoes including *Arceuthobium tsugense* as host plants in coniferous forests. This species may be a primary herbivore of dwarf mistletoe plants. These mistletoes occur mainly on western hemlock and occasionally true firs. Peak conditions exist in old-growth and late-successional second growth forests although younger forests with dwarf mistletoe may also support populations. This species typically spends much of its time in the top of the forest canopy which may contribute to the rarity of sightings.

Historic and Current Conditions

Historic and current occurrence in the watershed is not known. No surveys have been conducted in the watershed. Potential habitat exists in the mixed conifer PAGs in the watershed due to the occurrence of mistletoe. The only known occurrences on the Forest are on the Sisters Ranger District at Black Butte in 1993 and at Suttle Lake (date unknown).

Trends and Interpretation

The mistletoe parasite has increased in distribution and abundance during the past century as a result of fire suppression and selective harvest practices, which have possibly increased the habitat for the hairstreak. Conservation issues include loss of late-successional habitat, stand treatments to reduce dwarf

mistletoe, insecticide and herbicide applications, and hybridization/competition with the thicket hairstreak.

Evening Fieldslug

The Evening fieldslug is associated with perennially wet meadows in forested habitats. Microsites include a variety of low vegetation, litter and debris; rocks may also be used as refugia. This species appears to have high moisture requirements and is almost always found in or near herbaceous vegetation at the interface between soil and water, or under litter and other cover in wet situations where the soil and vegetation remain constantly saturated within 100 feet of perennial wetlands, springs, seeps and riparian areas (Duncan 2005). Many of the habitats where this species is found are wetlands less than one acre in size.

Historic and Current Conditions

Historic and current occurrence in the watershed is not known. No surveys have been conducted on the Forest. Potential habitat may occur at Bearwallow Springs on Forest land and at Bull Springs on private land, if these springs provide suitable perennially wet conditions.

Trends and Interpretation

Activities that lower the water table, alter the available moisture, compact soils, reduce litter and/or vegetative cover, or impact potential food sources could be deleterious to the survival and productivity of this species (Duncan 2005). Forest activities that could impact the fieldslug include snowmobiling, skiing, camping, removal of logs and woody debris for firewood collection, high-intensity fire, fire suppression/conifer encroachment, spring development or diversions, livestock grazing, and vehicle/heavy equipment use.

SURVEY AND MANAGE

Great Gray Owl

Great gray owls are generally associated with open forest of lodgepole and ponderosa pine with canopy closure ranging from 11-59%, dominated with grasses, open grassy habitat, including bogs, selective and clear-cut logged areas, and natural meadows (Bull and Henjum 1990). In these stands, optimum canopy cover for nesting ranges from 50-70%. Great gray owls have large home ranges of 1,000-2,000 acres (Natureserve 2008).

Historic and Current Conditions

It is questionable whether the watershed ever supported breeding pairs of great gray owls since the prefer habitat (wet and dry meadows interspersed with lodgepole pine) was probably very limited in scope and distribution. No surveys have been conducted in the watershed

Trends and Interpretation

Fire suppression has most likely led to a conversion of open meadow to pine stand in some areas, further restricting the habitat and potential for breeding pairs.

BATS: NORTHWEST FOREST PLAN, REGIONAL FORESTER SENSITIVE, AND LRMP MANAGEMENT INDICATOR SPECIES

The Northwest Forest Plan addresses bats in the Standards and Guidelines Attachment A under the following categories:

- Maintain adequate numbers of large snags and green trees, large down logs with loose bark in Matrix and Stand Management (Pages B-7 and C-42)
- Provide additional protection for caves, mines, and abandoned wooden bridges and

buildings that are used as roost sites for bats in Matrix (Pages C-43 and C-44) and Adaptive Management Areas (Page D-10)

Most bat species forage in openings in forested areas, forest edges, riparian habitat and slow moving streams, and lakes, ponds, and reservoirs. Bat species that could inhabit the watershed within the NWFP boundary include canyon bat, little brown myotis, Yuma myotis, Townsend's big-eared bat, pallid bat, big brown bat, California myotis, western small-footed myotis, long-eared myotis, long-legged myotis, silver-haired bat, and hoary bat. The silver-haired and hoary bats are tree-roosting bats and migrate during winter. The remaining 9 species of bats hibernate in caves and possibly rock outcrops and buildings during winter. Appendix 5 lists bats species that occur on the Forest and could occur in the subwatershed.

The Pallid bat, spotted bat, fringed bat, and Townsend's big-eared bat are Regional Forester Sensitive Species USDA FS 2011). The Townsend's big-eared bat is also a LRMP Management Indicator Species. The Townsend's big-eared bat is dependent on caves year-round for all life cycles. They may also use lava and rock outcrops and occasionally roost in trees, primarily in ponderosa pine PAGs. Cave habitats are not known to occur in the watershed. Townsend's may forage in the watershed during spring and fall movements between caves. There are no caves, bridges, or buildings in the watershed on Forest land.

Historic and Current Conditions

Historic or current use in the watershed by bats is not known due to a lack of surveys. The potential for hibernacula is low. The watershed likely provides habitat for migration and summer roosting including maternity colonies for tree-roosting bats, and cave bats which use snags, downed logs, and possibly rock outcrops. Current conditions are probably somewhat reduced compared with historic conditions, particularly in the ponderosa pine wet and dry PAGs due to the decline in large-diameter trees needed for roosting and loss of canopy cover from insects and disease. Bat species may use Bearwallow Springs, Bull Springs, wet meadows, and the intermittent streams when sufficient water is available for foraging. Tree encroachment into the springs and meadows could result in decreased foraging opportunities in these areas, although due to the small size of these areas, the impacts is likely minimal. Although the small amount of rock and cave habitat reduce the potential for the pallid or spotted bat to roost in the watershed, they may forage in the watershed due to presence of cliffs and large rock outcrops in the Tumalo Creek watershed to the south.

Trends and Interpretation

Small openings in dense forests from vegetation management and prescribed fire could result in improved foraging habitat at least in the short-term. Long-term, activities that move PAGs particularly ponderosa pine, towards large tree structure would benefit the majority of bat species found in the watershed. Timber management and prescribed fire during the reproductive period could result in abandonment or direct mortality or injury from tree felling and fire. Bats require a high density of snags for different roost uses, likely higher than the density required by woodpecker species. Vegetation management activities that reduce snag density and coarse woody debris long-term could negatively affect bats. Other threats for bats include danger tree removal, firewood and fuelwood collection, large-scale fire, and continued encroachment into wet meadows.

MANAGEMENT INDICATOR SPECIES AND HABITATS

Management indicator species (MIS) are selected because their welfare is presumed to be an indicator of the welfare of other species in the habitat. It is also a species whose condition can be used to assess the impacts of management actions on a particular area.

Red-tailed Hawk

Historical and Current Conditions

This species is suspected to have occurred mainly in areas after large fires or in areas of more open ponderosa pine LOS stands. Habitat types that provide suitable perches and are open enough to permit the detection of ground-dwelling prey will typically support red-tailed hawks. Historic or current presence in the watershed is not known due to a lack of surveys. Most available habitat is in the ponderosa pine PAGs on private land and in Deer Habitat. Red-tailed hawks have a wide tolerance for habitat variation, and commonly occur in areas close to human habitation.

Trends and Interpretation

Vegetation management activities that move stands in ponderosa pine PAGs toward LOS would benefit the red-tailed hawk.

Northern Goshawk, Cooper's Hawk, and Sharp-Shinned Hawk

Preferred nest stands for the northern goshawk have a minimum of 40% canopy closure and nest sites within these stands have >60% canopy closure (Reynolds et al. 1991). Mixed conifer wet and late-successional ponderosa pine wet are preferred PAGs for goshawk, although forest structure appears to be the more limiting factor to goshawk habitat rather than tree species. Cooper's and sharp-shinned hawks often use dense cover in which to hunt and nest. Cooper's hawks tend to select nest sites in dense second growth of mixed conifer or ponderosa pine stands (Jackman and Scott 1975). Moore and Henney (1983) noted that Cooper's hawks would routinely use mistletoe brooms as nesting sites. Sharp-shinned hawks utilize thickets in mixed conifer and deciduous woods.

Historic and Current Conditions

Historically, the abundance and quality of suitable habitat for northern goshawks was higher than the current level. Habitat was available in the ponderosa pine wet and dry PAGs, and mixed conifer dry PAG under historic conditions. Surveys have not been conducted in the watershed; however goshawks have been reported in the Tumalo watershed to the south. Habitat distribution has diminished, mainly due to the timber harvest and road building at mid- and lower elevations.

Historically, the abundance and quality of suitable habitat for Cooper's and sharp-shinned hawks is fairly similar to current conditions.

Trends and Interpretation

Loss of habitat within the ponderosa pine and mixed conifer PAGs has restricted habitat available to goshawks. Areas now considered suitable are at high risk to stand replacement events due to the dense nature of these stands.

Much of the habitat for Cooper's and sharp-shinned hawks is at risk to loss by large-scale fire. Many of these stands are dense and have high amounts of mistletoe and insects and disease. The loss of this habitat by these factors and timber harvest (commercial and pre-commercial thinning) would most likely reduce the amount of available habitat within the watershed.

Woodpeckers (Cavity-Nesters)

Woodpeckers was chosen as a MIS group in the Forest LRMP to represent all wildlife species which use cavities for nesting and denning. Woodpeckers, as well as many of the secondary cavity nesters, consume forest insects, thereby contributing a valuable suppression influence on destructive forest pests (USFS 1990, p. 3-17). On the Forest, eleven woodpecker species excavate cavities used by other species of hole-nesters that are incapable of excavating their own nest sites. Ten of these species have potential habitat in the Bull Creek subwatershed (Appendix 3). Both the White-headed woodpecker and Lewis's woodpecker were assessed in the Regional Forester Sensitive Species section.

Historic and Current Conditions

Historic and current presence is not known for any of the woodpecker species in the watershed due to a lack of surveys.

Williamson's sapsucker: Suitable habitat for this species in the LOS mixed conifer PAGs and LOS ponderosa pine PAGs would have been greater historically than today.

Black-backed and three-toed woodpeckers: Habitat for these species has likely increased in areas of the watershed over the past 10-15 years due to the increase in insects and disease; however across the landscape, snags suitable for nesting were likely greater historically.

Pileated woodpecker: Habitat for this species has probably increased in suitability since fire suppression has allowed accumulations of down logs as well as understory intrusions of white fir within some stands historically lacking any significant understory vegetation. Current availability of suitable habitat is less than it was historically due to the reduction in LOS stands.

Hairy woodpecker: This species uses variety of habitats and snag sizes. Historically, it was most likely common, utilizing habitats within a variety of age classes in the ponderosa pine and mixed conifer PAGs.

Northern flicker: This species is generally abundant in open forests and forest edges adjacent to open country but requires large snags or large trees with decay to build their nests. Current availability of suitable habitat is less than it was historically due to the reduction in LOS stands.

Downy woodpecker: Habitat for these species is often associated with deciduous and mixed deciduous-coniferous forests or riparian areas and is very limited in the watershed. Current and historic conditions are likely similar.

Red-naped sapsucker: The red-naped sapsucker breeds in cavities in aspen, riparian cottonwood, ponderosa pine, mixed conifer, and white fir. Unlike most other woodpecker species, they forage in healthy trees as well as dead/decayed trees. Current and historic conditions are likely similar.

Trends and Interpretation

With increased stand densities and insects and disease, areas in the watershed are at high risk to loss by large-scale fire, which would negatively impact woodpecker species with the exception of black-backed and Lewis's woodpeckers. Where large diameter ponderosa pine still exists at lower elevations, fire suppression has led to understory intrusions by various tree species that essentially creates unsuitable conditions. Vegetation management that moves stands toward LOS conditions would benefit most woodpecker species. Forest activities including hazard tree removal, and removal of trees for firewood and fuelwood collection would remove standing snags beneficial to woodpeckers for nesting and foraging.

The black-backed woodpecker is a landbird focal species for old-growth lodgepole pine under the Conservation Strategy. Conservation issues include a reduction in mature and old-growth lodgepole pine trees due to timber harvest, insect outbreaks, wildfire suppression, overstocked stands, and salvage logging. Biological objectives include maintaining or providing large tracts (> 1,000 acres). Potential habitat exists in small to medium sized lodgepole pine snags greater than 8" dbh in stands with > 25% canopy closure in lodgepole pine, mixed conifer, and mountain hemlock stands. Lodgepole pine stands allowed to cycle naturally will continue to provide habitat. The threat of risk to catastrophic fire increases the potential for future available habitat for this species.

The red-naped sapsucker is a landbird focal species under the Conservation Strategy for large aspen trees and snags with regeneration (Altman 2000). Conservation issues and biological objectives focus exclusively on aspen stands of which there are none in the watershed.

The Williamson's sapsucker is a Landbird focal species under the Conservation Strategy for large snags in mixed coniferous habitat. Conservation issues include loss of large diameter snags and decayed trees

from timber harvest and wildfire suppression/overstocked stands that have inhibited growth of large trees (Altman 2000). Biological objectives under the Conservation Strategy include providing > 1 snag per acre > 12" dbh except ponderosa pine which should be > 18" dbh and a mean canopy cover of 25-70%.

The LRMP uses potential population levels to manage for viable woodpecker populations across the forest. This was the best available science at the time the LRMP was developed. However, new science has emerged that discourages the use of this method because additional snags and habitat are required for foraging, denning, nesting, and roosting to fully meet the needs of primary and secondary cavity nesters (Bull et. al 1997, Rose et al. 2001). In addition, the current LRMP direction provides recommendations for green stands only, and research shows that cavity-nesting birds require higher snag densities in post-fire conditions versus green stands for nesting and productivity. This is likely due to cavity-nesting birds requiring more snags for foraging, cover, and protection from predators in post-fire environments.

The following information is summarized from the 2012 MIS Pileated Woodpecker Report (Turner 2012).

DecAID is a web-based advisory tool to help managers evaluate effects of forest conditions and existing or proposed management activities on organisms that use snags and down wood. It is a summary, synthesis, and integration of published scientific literature, research data, wildlife databases, forest inventory databases, and expert judgment and experience. The information presented on wildlife species use of snags and down wood is based entirely on scientific field research and does not rely on modeling the biological potential of wildlife populations (Mellen McLean et al. 2009).

DecAID contains two major data sets which are summarized by wildlife habitat types. The inventory data is comprised of statistical summaries of forest inventory data on snags and down wood in unharvested forests and entire landscapes across Oregon and Washington. The wildlife data is derived from a thorough review of published literature and other available data on wildlife use of snags and down wood, primarily in Oregon and Washington. DecAID provides a statistical synthesis of data showing levels of use by individual wildlife species of snags and down wood. Wildlife use data are not available for all wildlife habitat types.

Wildlife data as used in DecAID refers to the data collected in a variety of wildlife studies conducted in specific vegetation types found in the West. Most of the data collected is for bird species, primarily cavity nesters such as woodpeckers. The wildlife data in DecAID is provided in the form of tolerance levels of 30, 50, or 80 percent.

Data is displayed by tolerance level for both wildlife data and inventory data. Tolerance levels are similar to confidence levels with one key difference: "tolerance intervals are estimates of the percent of all individuals in the population that are within some specified range of values" (Mellen-McLean et al. 2009). For example, using data from the wildlife species curves for pileated woodpeckers from the Eastside Mixed Conifer Forest, Larger Trees (EMC_L) wildlife habitat type, we can say (with 90% certainty) that in the EMC_L vegetation condition:

- 30% tolerance level = 64.5 cm (25.1 in), thus, 30% of the nest snags used by pileated woodpeckers are <64.5 cm dbh and 70% of the nest snags used by pileated woodpeckers are >64.5 cm dbh
- 50% tolerance level = 74.8 cm (29.2 in), thus, 50% of the nest snags used by pileated woodpeckers are <74.8 cm dbh and 50% of the nest snags used by pileated woodpeckers are >74.8 cm dbh
- 80% tolerance level = 90.6 cm (35.3 in), thus, 80% of the nest snags used by pileated woodpeckers are <90.6 cm dbh and 20% of the nest snags used by pileated woodpeckers are >90.6 cm dbh

The inventory tolerance levels are calculated at 30%, 50%, and 80% as well using the same certainty level of 90% applied to the wildlife data making the inventory data directly comparable to the wildlife data.

However, the inventory tolerance levels are calculated differently, using a non-parametric method that doesn't require assuming dead wood data are normally distributed.

DecAID is not a viability model, and thus tolerance levels should not be interpreted as population viability "thresholds." DecAID tolerance levels "may be interpreted as three levels of "assurance": low (30% tolerance level), moderate (50% tolerance level), and high (80% tolerance level)" (Mellen McLean et al. 2003). The higher the tolerance level, the higher the "assurance" that snag habitat is being provided.

Appendix 4 summarizes DecAID information queried in 2012 on snags and down wood for six species of woodpeckers in the Bull Creek subwatershed: Williamson's sapsucker, white-headed woodpecker, three-toed woodpecker, pileated woodpecker, hairy woodpecker, and black-backed woodpecker.

Elk

The Forest LRMP established eleven Key Elk Areas (KEHAs) to provide conditions needed to support at least 1,500 summering elk and 240 wintering elk. The Deschutes LRMP specifies S&Gs for elk hiding and thermal cover, road densities and recreation management in these KEHAs. There are no KEHAs in the Bull Creek subwatershed. The Deschutes LRMP also specifies protection of riparian areas for calving outside KEHAs. The closest KEAs are Tumalo Mountain and Ryan Ranch KEAs, 3.5 miles and 5.5 miles to the south.

Elk in the Bull Creek subwatershed are in the ODFW Upper Deschutes Management Unit. A portion of the elk herd winters above Bull Springs or may head south to winter near the Inn of the Seventh Mountain.

Historic and Current Conditions

Elk densities in the watershed were historically very low to nonexistent. State biologists did not notice elk presence in the area with any regularity until the 1970s and significant increases in the herd were not seen until early 1990s. Populations for the Upper Deschutes Management Unit are stable or increasing.

Trends and Interpretation

Elk numbers continue to increase throughout the Upper Deschutes Management Unit, but growth is expected to slow as the herd nears carrying capacity. Elk thermal and hiding cover is found primarily within the mixed conifer, lodgepole pine, and mountain hemlock PAGs on Forest lands in the subwatershed. Roads 370 and 4601/4602 provide the bulk of hunter access into roadless and wilderness areas. Improvements to these roads could result in increased use in general in the watershed, and possibly more hunting and poaching pressure on elk.

Mule Deer

The LRMP established Management Area 7 Deer Habitat (MA7) to manage vegetation for habitat conditions on deer winter and transition ranges, considering the optimum productivity of the land. MA7 also provides opportunities for some domestic livestock forage, wood products, visual quality, and recreation opportunities. There are 1,785 acres in LRMP Deer Habitat (MA7) in the Bull Creek watershed along the eastern edge of the Forest boundary. The private land owned by Fidelity Bank to the west is also considered winter range by ODFW. The ODFW established herd management objectives (MO) for winter deer populations based on buck to doe ratio and fawn recruitment within four Wildlife Management Units (WMUs) on the Forest. Bull Creek subwatershed is in the Upper Deschutes WMU.

Deer summer range includes all other PAGs outside MA 7, although some use during summer takes place in transition and winter range areas. Management of deer habitat outside of MA7 is designed to provide adequate habitat quantity and quality to meet MOs. This requires a mosaic of forested conditions incorporating the concepts of security and thermal cover, travel corridors, visual screens, and harassment reduction from other activities including roads, hunting pressure, and other recreational use.

In the watershed, deer summer range occurs in the western portion in the higher elevations of mountain hemlock, lodgepole, and mixed conifer PAGs. The winter range is in the ponderosa pine PAG lower elevations. Mule deer migrate west-east between higher elevations in summer to lower elevations during winter.

The Deer Habitat and private land to the west are within the Tumalo Deer Winter Closure area. This area is closed to all unauthorized vehicle travel except on designated roads unless granted by a waiver from ODFW. Federal, State and County employees are permitted entry in performance of official duties

Historic and Current Conditions

The following information is based on (Gregg, M. 2012): Across the state, mule deer increased during the 1930s and 1940s compared with historic accounts in the late 1800s. Mule deer populations peaked from 1950-1970 but then began to decline. The Upper Deschutes population has declined further since the last ODFW mule deer plan in 2002. The winter population MO for the Upper Deschutes is 2,200 individuals. MOs for buck to doe ratios are being met and allowable harvest has not changed; however, due to population decline and low fawn recruitment, very minimal antlerless harvest occurs. Anecdotal information suggests that deer populations in the watershed were historically low, and probably never underwent the radical boom and bust observed for herds at lower elevations. Over the last 100 years, aside from intensive logging on private lands, the habitat has remained fairly static. While human access has increased in the middle and lower portions of the watershed, much of the higher ground is relatively inaccessible for most of the public.

Although the Forest thermal cover is low, hiding cover in summer range (outside MA7) in the Bull Creek watershed totals 4,632 acres out of 7,179 acres, or 65% of the watershed. Open road densities exceed LRMP thresholds.

Trends and Interpretation

Shrubs occur mostly in early successional habitats—those recently disturbed and those maturing to climax state. Disturbance events in forested areas including wildfire, prescribed fire, wind storms, insect infestation, tree disease, and timber harvest are key elements in maintaining these shrub components. Inadequate foraging habitats in or adjacent to summer range can be a limiting factor for winter conditioning and survival. Mule deer are migratory and move from high-elevation summer ranges to low-elevation winter ranges where foraging is easier under reduced snow depths. Where deer winter in forests with deep snow conditions, removal of forest canopy may have deleterious effects on deer survival. The habitat carrying capacity is low due to a lack of openings in good forage habitat.

Suburban development of the private land owned by Fidelity Bank in the ponderosa pine PAGs would severely affect mule deer winter range and east-west migrational movements of deer between the winter and summer ranges (Barbour 2009). In addition, impacts could occur from increased vehicle collisions, harassment from dogs, and increased risk of fire. These same impacts could also affect the LRMP Deer Habitat allocation to the east on Forest land. Existing thermal cover in the ponderosa pine PAGs is generally low.

Roads 370 and 4601/4602 provide the bulk of hunter access into roadless and wilderness areas. Improvements to these roads could result in increased use in general in the watershed, and possibly more hunting and poaching pressure on deer.

American Marten

Suitable habitat for marten consists of late structure lodgepole pine and mixed conifer wet stands and to some degree mid-structure lodgepole. Home range sizes vary widely, ranging from 600 acres to 2,500 acres. Canopy closure varies from 40 to 80%.

Historic and Current Conditions

Historic levels of habitat fragmentation, which reduces habitat suitability for marten, most likely varied for any given century, but would have been more prone to isolated large acre events in lodgepole pine, and less so in mixed conifer wet plant associations. Marten sightings have been reported in the Bull Creek Subwatershed, although formal surveys have not been conducted. Sightings have also been reported immediately north and south, indicating a high probability of marten presence in the watershed. Acres of suitable marten habitat are less than historic conditions due to a large decrease in LOS mixed conifer wet stands and LOS lodgepole pine, being replaced by mid-structure lodgepole pine and mountain hemlock. However, snags and down logs in mixed conifer stands have accumulated due to fire suppression, further increasing habitat suitability in some stands that may have been of marginal suitability historically.

Trends and Interpretation

Retention of the Bearwallows IRA in the mixed conifer wet and lodgepole pine PAGs has allowed stands to cycle naturally, providing large areas suitable for marten. Threats to marten include recreational disturbance particularly in winter, and removal of lodgepole pine for firewood and fuelwood collection and hazard tree removal.

Species Associated with Logs and Downed Wood

The amount of down logs and green tree replacements has not been quantified for the watershed. Due to past management treatments, insect and disease outbreaks, and wildfire, gaps exist in both the distribution of available dead wood habitat and future snag and down log replacement trees. The species associated with logs and downed wood are Woodpeckers and American Marten previously discussed under the MIS section and bat species previously discussed under the Bats section.

Species with Special or Unique Habitats

The unique habitats in the subwatershed include springs and seeps. Species potentially associated with springs and seeps include the Silver-bordered fritillary and evening fieldslug previously discussed under Regional Forester Sensitive Species.

LANDBIRD FOCAL SPECIES

The 2001 Executive Order 13186 provides for enhanced cooperation between the Forest Service and USFWS to address impacts to neotropical migratory birds and contribute to their conservation. In response to this Executive Order and compliance with the Migratory Bird Treaty Act, the Deschutes follows guidelines from the Conservation Strategy for Landbirds of the East-Slope of the Cascade Mountains in Oregon and Washington (Altman 2000). This strategy addresses key habitat types, biological objectives, and conservation strategies for these habitat types found in the east slope of the Cascades, and the focal species associated with these habitats. The conservation strategy lists priority habitats and associated focal species for: (1) Ponderosa Pine, (2) Mixed Conifer (Late Successional), (3) Oak-Pine Woodland, and (4) Unique Habitats (Lodgepole Pine, White Bark Pine, Meadows, Aspen, and Subalpine Fir). There is no Oak-Pine Woodland in the Bull Creek Subwatershed. Appendix 6 lists priority and associated landbird focal species and habitat/occurrence in the Bull Creek subwatershed.

BIRDS OF CONSERVATION CONCERN

High Priority Shorebirds

Birds of Conservation Concern (BCC) include species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the ESA (U.S. Fish and Wildlife Service 2008). While all of the bird species included are priorities for conservation action, the list makes no finding with regard to whether they warrant consideration for

ESA listing. The goal is to prevent or remove the need for additional ESA bird listings by implementing proactive management and conservations actions (USDI FWS 2008). Bird Conservation Regions were developed based on similar geographic parameters. The Bird Conservation Region 9 (Great Basin) list is used for the Forest.

The U.S. Shorebird Conservation Plan (USDI FWS 2004) identifies the conservation status of U.S. and Canadian shorebird populations, ranking them with five conservation categories. Species considered Highly Imperiled or of High Concern are considered for the Forest. Due to the lack of water on Forest land, there is little likelihood of occurrence of any shorebird species. Some shorebird species occur on Tumalo Reservoir on private land in the watershed east of the Forest boundary.

Appendix 7 lists BCC and High Priority Shorebirds considered for the Forest and whether there is potential habitat/occurrence in the Bull Creek watershed.

RECREATION

CHARACTERIZATION

Recreational opportunities and use in the Bull Creek watershed are divided into two primary categories: Semi-Primitive Motorized and Primitive Non-Motorized. These categories, based on the Recreation Opportunity Spectrum (ROS), offer forest users a wide range of options in a primarily undeveloped watershed. Ownership of adjacent lands in the Bull Creek watershed include urban development near Bend and Tumalo, privately owned timberland, federal lands managed by the BLM, and State of Oregon lands near Tumalo reservoir.

Due to the lack of developed sites and improved road systems Bull Creek is not a recreation destination location. Even though most of the roads originate in urban areas, most of all the use in Bull Creek is considered Dispersed. Developed trails do exist within Bull Creek, but they are primarily used by a private guest ranch for horse use and not promoted for public use. Groomed winter trails exist as well, but for the most part are all exclusively on Forest Service system roads.

Those roadless portions of the Bull Creek subwatershed offer scenic values within the viewshed of the Three Sisters Wilderness for several Central Oregon Communities including Bend, Tumalo, Sisters and Redmond. The adjacent drainages to Bull Creek make it part of a much larger landscape known by many locals as the "Foothills of the Cascades".

DEVELOPED RECREATION

There are no developed recreation sites within Bull Creek Watershed.

MOTORIZED RECREATION

Motorized recreation in Bull Creek is restricted to open FS Roads only. The season of use is typically from May to November. Scenic driving is the most popular of all motorized recreation. OHV use and motorized camping are evident, but are considered low use. In the winter, primarily from December to April, snowmobiling is very popular along the groomed trails.

Scenic Driving

- **FS Road 370:** The subwatershed is bounded on its western edge by FS Road 370, a scenic drive in summer months between Cascade Lakes Highway and Three Creek Lake. Due to poor road conditions and the need for a high clearance vehicle, use on this road is fairly low. Only a small portion of the 370 (less than a mile) passes through the watershed.
- **FS Road 4602:** Continuing from Skyliner Road (FS Road 4601), FS Road 4602 is the main route to Triangle Hill, a popular destination for scenic views of Central Oregon. The 4602 is a higher maintained road than others in Bull Creek. Most vehicles can travel this road making it the most popular drive within the watershed. Triangle Hill is a short easy drive from the 4602 to a scenic overlook.
- **FS Road 4606:** FS Road 4606 is a popular scenic drive from Bend to Sisters. Located on the Eastern edge of the watershed, this road provides access to Federal lands near Tumalo Reservoir. It also serves as a main travel route for the community of Plainview. Recreationists utilize this road because it provides access to low elevation dispersed camping and mountain bike trails near Sisters. There are no known recreation destinations adjacent to this road.

OHV

All motorized recreation is restricted to designated roads only. Class III vehicles (motorcycles) are the most prevalent of all OHV users within this subwatershed. There are a limited amount of Class II (Jeep)

opportunities. Again, they are restricted to open roads only. Overall, OHV use in the watershed is considered low.

There are no designated motorized trails other than groomed snowmobile trails, which are restricted to FS roads.

Motorized Dispersed Camping

Generally, motorized dispersed camping is limited to FS Roads 370 and 4602. User created access to dispersed sites is a generally about 200 feet from system roads. As of 2010, there have been two dispersed sites inventoried on FS Road 370 and seven dispersed sites inventoried on FS Road 4602 within the Bull Creek subwatershed. All sites have a low impact rating and low use.

Snowmobiles and Over Snow Vehicles

FS Road 370 and FS Road 4602 are part of the groomed snowmobile trail system in the winter, typically operating December thru April. FS Road 370 is the main route between Ducthman and Three Creek Snow Parks. Off trail riding is popular along these routes with some cross-country riding in the subwatershed. Snowmobile use is considered moderate on groomed trails and considered light within Bull Creek. Remote ponds are destinations within the IRA portion of the drainage for snowmobiling.

NON-MOTORIZED RECREATION

Non- Motorized recreation within the Bull Creek watershed is fairly limited to a handful of opportunities that include hiking, horseback riding, camping & hunting. No developed trailheads or campgrounds exist within this watershed. Official FS trails exist in Bull Creek, but access is fairly limited.

Hiking

There are no primary hiking trails in the subwatershed. Hiking is allowed on the Metolius–Windigo Trail, but this trail is a dedicated equestrian trail that sees little to no hiking use.

Equestrian

The Metolius-Windigo Trail is the only designated FS trail within the watershed. Approximately ¾ of a mile of this trail is constructed on the eastern edge of the 370 road and passes through the head of the drainage. Equestrian use along this portion of trail is considered low and has a short season due to its elevation.

Mountain Biking

There are no primary mountain bike trails. Biking is allowed on the Metolious-Windigo Trail, but due to the equestrian use this trail receives the tread is not appealing for mountain bike riding.

Camping

Dispersed camping within the subwatershed is limited to only a select few locations. The watershed has three inventoried dispersed sites within the IRA. All are near ponds off the 370 road. Due to the lack of developed trails, most of the Bull Creek drainage has seen no dispersed camping use other than during hunting season.

Hunting

Hunting use is moderate during rifle season for deer and elk. It is considered low for archery and other hunts. Late August through November is typically the highest use from hunters. Most are associated with motorized dispersed camping and hunting from those camps occurs on foot or horseback into the IRA portion of the watershed.

Fishing

There are no fish or known fishing opportunities in the Bull Creek watershed.

RECREATION SPECIAL USE PERMITS

Currently there is one recreation special use permit within the Bull Creek watershed that is active. There has also been a termination of a permit that has a trail system associated with the permit.

Sno-Gophers Grooming

The Sno-Gophers are a snowmobile grooming club that operates on both the 370 and the 4602 roads. A special use permit is active with the club to allow grooming of these winter trails. Grooming occurs between December and April and is funded through the State of Oregon. Approximately ¾ of a mile of trail is groomed on the 370 road and 4 miles of trail is groomed on the 4602 within the watershed.

Rock Springs Guest Ranch

No longer active, a special use permit had allowed for 13 miles of trail and 19 miles of road to be open for use by the Rock Springs Ranch. Located on the eastern edge of the watershed near Tumalo reservoir, this permit had been active for several years.

None of the trails were constructed by the FS nor had they been evaluated on their integrity. These trails are currently under evaluation.

SCENIC RESOURCE

FOREST PLAN DIRECTION

FRONT COUNTRY

The goal of this Management Area is to provide and maintain a natural appearing forested landscape on the slopes east of the Three Sisters Wilderness and southeast of Tam MacArthur Rim while providing high and sustainable levels of timber production. Although a greater emphasis is on timber production, the Visual Quality Objective is Medium Scenic Integrity (Partial Retention) for view areas.

Front Country Management Area standards and guidelines for Scenic Views focuses on maintaining a uniform tree canopy in areas visible from significant viewer locations. Openings are acceptable but should not dominate the landscape when uniform tree canopies cannot be maintained because of biological or topographic conditions.

Openings resulting from vegetative management activities in areas viewed from significant viewer locations will be designed to follow natural topographic features, to avoid geometric shapes and straight lines, and to be sized to simulate naturally occurring openings.

For management activities which may result in visible openings in the forest canopy, consult a landscape architect on the location, size and configuration for treatment units. Portions of the area which cannot be seen from the significant viewer locations will be managed similarly to land in the General Forest Management Area.

CURRENT CONDITIONS

The major transportation corridor through this area is US Highway 20 which connects Bend to the town of Sisters. The project area is visible from this main travel corridor which is located in the eastern portion of the subwatershed, dividing private lands. Scenic View Management Areas are Front Country Seen and Front Country Unseen which are located in the western portion of the project area. The Front Country Seen Management Area includes Bearwallow Butte. Recreational driving occurs on back roads in a semi-primitive wilderness to vista lookout points at Bearwallow Butte and Triangle Butte. Hunting also occurs in this area along with dispersed camping and a more isolated recreation experience is possible.

BOTANICAL RESOURCE

EXISTING CONDITION

This watershed analysis focuses on the 12th field Bull Creek sub-watershed (Hydrologic Unit Code 170703010603) which is one of four sub-watersheds within the 10th field Deep Canyon Watershed (Hydrologic Unit code 1707030106).

THREATENED, ENDANGERED AND SENSITIVE PLANTS

No Threatened or Endangered plant species, or their habitats, occur in the Bull Creek sub-watershed nor are they suspected to occur on the Deschutes National Forest.

The Forest Service Region 6 (Oregon and Washington) Regional Forester's Sensitive Species List was officially updated on January 31, 2008. The Deschutes National Forest Sensitive Plant List includes 57 taxa, either known or suspected to occur on the Forest: 36 vascular plants, 13 bryophytes, 3 lichen, and 5 fungi (Appendix 1). A relatively small portion of the watershed has been surveyed for these sensitive plants; there have been limited surveys in the Tumalo Reservoir area in the northeast portion and along drainages in the west portion.

Peck's milkvetch (*Astragalus peckii*) is the only know sensitive plant that occurs within the sub-watershed in the Bull Flat area. Peck's milk-vetch is a perennial legume found in non-forested areas, forest openings, and open forest. It is most commonly found in shrub-steppe plant associations, but has also been reported from common juniper woodlands, ponderosa pine forest edge and lodgepole pine forest openings. It grows in loose, deep pumice, loamy sand, or sandy soils with flat to gentle slopes. It has often been found in or along dry watercourses, old lakebeds (basins), pumice flats and other natural openings. Additional sites occur in the same general area as the Forest Service site, on lands managed by Bureau of Land Management and may occur on private lands.

Potential Habitat for Sensitive Plant Species

A small spring (~ one acre in size), Bearwallows Spring, occurs in Bull Creek sub-watershed southwest of Bearwallow Butte and has not been surveyed for sensitive plants. The following sensitive plant species could potentially occur within this spring:

- **Capitate sedge (*Carex capitata*)** –This species occurs in wet or seasonally wet meadows, often alpine but also at lower elevations in cold air drainages or cold springs. In the Pacific Northwest, it is often found on sandy, acidic soils. Though in other places it grows on diverse soils (peat, sand, gravel, often limestone), usually where the snowpack is shallow but the ground remains moist in summer due to snowmelt. There are 14 known sites of capitate sedge on the Deschutes National Forest; one site occurs in adjacent Tumalo Creek Watershed (USDA Forest Service 2008).
- **Lesser bladderwort (*Utricularia* minor)** – This submerged insectivorous plant is found in shallow, standing or slow-moving water that has poor nutrient quality. There are 10 sites currently on the Deschutes National Forest; one of these sites occurs in a fen in the northwestern portion of adjacent Tumalo watershed.
- **Moss (*Tomentypnum nitens*)** – Habitat for this moss is slightly raised hummocks, logs, or stumps in medium to rich montane fens in elevations ranging from 5,000 to 6,000 ft. A constant source of low-volume moisture appears to be a critical habitat component for this moss. It occurs on all three Ranger Districts of the Deschutes National Forest, including two sites, both small fens, within adjacent Tumalo Creek drainage.
- **Forest brownwort (Liverwort) (*Tritomaria exsectiformis*)** – The typical habitat for this species is open to shaded coniferous forest in association with low volume, perennial water flow at or near springs and seeps, along very gentle topographic gradients. Lodgepole pine

(*Pinus contorta)* is present at nearly all sites of *T. exsectiformis* within the Oregon and Washington Cascades. Other tree species occurring at these sites include white fir, ponderosa pine, Engelmann spruce (*Picea engelmannii)*, Douglas fir (*Pseudotsuga menziesii)*, western hemlock (*Tusga heterophylla)*, mountain hemlock (*Tusga mertensiana)*, and subalpine fir (*Abies lasiocarpa)*. Currently, all but one of the *T. exsectiformis* sites in the Oregon and Washington Cascades occur within spring-fed hydrologic systems.

- **Newberry gentian (*Gentiana newberryi*)** – This low-growing perennial herb is found in montane wet to dry meadows, sometimes adjacent to springs, streams, or lakes. It is found on the Sisters and Bend/Ft. Rock Districts of the Deschutes National Forest; populations of Newberry gentian occur in adjacent Tumalo Creek watershed.

SURVEY AND MANAGE PLANT SPECIES

A portion of Bull Creek Sub-watershed occurs within the Northwest Forest Plan (5,394 acres of the total 32,153 sub-watershed acres). The majority of this area (4,608 acres) is in Matrix allocation plus 634 acres of Administratively Withdrawn areas and 152 acres of Congressionally Reserved areas. Areas within the Northwest Forest Plan are subject to Survey and Manage Standards and Guidelines that intend to mitigate impacts of land management efforts on species that are closely associated with late-successional or old-growth forests and whose long-term persistence is a concern (USDA Forest Service and USDI Bureau of Land Management 2001). These measures apply to all land allocations within the Northwest Forest Plan area and require land managers to take certain actions relative to these Survey and Manage species. These actions include: (1) manage known sites; (2) survey prior to ground-disturbing activities; and (3) conduct extensive and general regional (strategic) surveys.

There are no documented Survey & Manage plant species in the Bull Creek sub-watershed.

Sites of two fungi occur in the adjacent Three Creeks sub-watershed (Hydrologic Unit Code 170703010601) which is also part of the larger Deep Canyon watershed:

- *Elaphomyces subviscidus* is a truffle (it forms sporocarps beneath the soil surface) and is associated with the roots of lodgepole pine (*Pinus contorta*) and mountain hemlock (*Tsuga mertensiana*) at high elevation (2,200 meters) (Castellano et al. 1999).
- *Nivatogastrium nubigenum* is a fungus that fruits on the surface of rotten fir (*Abies* spp.) logs at high elevation (about 1,300 m.) (Castellano et al. 1999). It is known on the Deschutes National Forest in the Three Creeks Lake area, on Tumalo Mountain trail, and on Odell Butte.

Little is known about these fungi species and their habitat preferences could be broader than defined above; therefore, potential habitat could possibly occur in the Bull Creek sub-watershed.

INVASIVE PLANTS

There have been limited invasive plant surveys in the Bull Creek sub-watershed. Though there are no documented sites, invasive plants may exist but have not yet been detected. Disturbed areas in the dry ponderosa pine, sage, and juniper habitats in the north eastern portion of the sub-watershed have a high probability of being infested with common invasive plants such as spotted and diffuse knapweeds and cheatgrass. This area includes the Tumalo Reservoir area and a mix of private, state, and Bureau of Land Management lands.

The following invasive plant species are known to occur in adjacent watersheds, and therefore, have a probability of existing within or moving into the Bull Creek sub-watershed:

- Spotted knapweed (*Centaurea biebersteinii*) and Canada thistle (*Cirsium arvense*) occur in the Tumalo Creek floodplain in adjacent Tumalo Creek Watershed (USDA Forest Service 2008).
- Dalmation toadflax (*Linaria dalmatica*) occurs along Skyliner Road (FS Rd. 4601) in adjacent Tumalo Creek watershed; this road is used to access portions of the Bull Creek sub-watershed.

- Diffuse knapweed (*Centaurea diffusa*) occurs along FS Rd. 4606, which eventually crosses the Bull Creek sub-watershed.

Overall, there is a relatively high risk of invasive plants spreading into this sub-watershed along roads, which serve as conduits for spread of weed seeds, through recreational activities, or from large scale fires and the activities related to fire suppression. Appendix B lists the invasive plant species documented on the Deschutes National Forest and are potential candidates for invasion.

SOIL RESOURCE

The soil resource within the Bull Creek Subwatershed is dominated by ash and pumice from Mt. Mazama, glacial till and other reworked volcanics. At the higher elevations of the watershed ash overlies volcanic bedrock and glacial till. Vegetation includes mountain hemlock and lodgepole pine with an understory of huckleberry, sedges, woodrush, and other species. Site quality at this elevation is very low for timber production due to cold temperatures and a short growing season.

At a slightly lower elevation and within the future Ursus planning area there are a number of cinder cones. The higher elevation cinder cones occur at elevations above 6,000 feet. These landforms have slopes ranging from 20 to 70 percent and are also considered low to unproductive for timber production. They do however; produce a variety of tree species including true firs, lodgepole pine, and western white pine. Below 6,000 feet other cinder cones in the area produce stands of mixed conifer with a site potential of site index 70 to 95 for ponderosa pine. These landscapes are very stable having excessively well drained soils derived from a moderately thick layer of pumice and volcanic ash over an older soil on cinders. Very limited vegetation management has occurred in this are in the recent past.

The central portion of the watershed consists of uneven glaciated lands and areas with glacial moraines from about 5,000 feet down to 4,500 feet elevation. Dominate trees species include fir and ponderosa pine with a site potential site index of 80 to 100 for ponderosa pine. Below 4,500 feet and down to an elevation of around 3,400 feet soil have developed on gentle to uneven lava plans that have been covered with Mazama ash deposits. Rocky outcrops are common in this area. Vegetation consists of ponderosa pine with a manzanita, bitterbrush understory. Due to lower precipitation compared to the upper elevations site potential for ponderosa pine drops to a site index of 70 to 85. This area is currently in private holdings and has had moderate to extensive management in the recent past. Soil disturbances are expected to be moderate to high as a result of this recent management.

Soil types in the lower forest elevations and within the DNF LRMP Forest Plan Allocation MA-7 (Deer Winter Range) consist of Mazama ash deposits that occur on gently sloping glacial outwash plains and terraces. Timber stands in the area consist of ponderosa pine and juniper, however; due to the low amounts of precipitation in the area these soils are considered low quality for timber production. The eastern one third of the watershed that is outside of the Deschutes National Forest has soils predominately consisting of Mazama ash deposit overlying basaltic bedrock. Vegetation includes juniper/sage woodlands having very low precipitation and productivity. Land use includes homes and rangelands.

Table 13: Soil Stratum/Land Types of the Bull Creek Subwatershed

Land Type	Soil Parent Material	SRI Landtype #'s	Percent
Gentle to uneven glaciated uplands	ash over glacial till or bedrock	12, 15, 16, 17, 19, 22, 25, 27, GG, GK, GJ, MG	31
High elevation cinder cones	cinder	83	1
Mid elevation cinder cones	cinder	82, HN	2
Uneven glaciated uplands and glacial morains	ash/till	48, 64, 66, 68, 72, LG, LK, MK, TD	39
Lava flows	basalt bedrock	14	2
Riparian or ephemeral drainages	steep bedrock sideslopes and alluvium bottoms	8, 10	2
Gently sloping glacial outwash plains and terraces	ash/outwash	36, XD	23
Totals			**100**

*The land type groups were stratified primarily by parent material and underlying geology using groupings of the Deschutes Soil Resource Inventory (SRI) land type mapping units.

CHARACTERIZATION

Soil profiles within the subwatershed generally have distinct horizons stratified according to the timing of material deposition and the amount of weathering of the mineral components of the stratum. The majority of the subwatershed has a moderately deep cap[layer of wind deposited ash and pumice overlying glacial till or glacial outwash materials. Glacial materi9als are absent from the eastern most portion of the subwatershed outside of the Forest boundary. In the area, either basaltic bedrock or a layer of residual soil weathered from basaltic lavas underlies the ash cap.

The bulk density and soil strength of the surface mineral horizons and rooting zones of the soils present within the subwatershed are naturally low due to the inherent characteristics of the ash and pumice material comprising these fractions. Physical disturbances capable of compacting mineral soil or mixing the natural stratification of soil horizons were historically limited. Landslides (also referred to as debris torrents) had the potential for increasing the soil strength of the rooting zone by exposing higher density subsurface materials such as glacial till or by accumulating material in a deep mass down slope. Evidence of this mechanism on a measureable scale within the subwatershed is limited. Glaciation was the primary historic disturbance within the subwatershed prior to the deposition of the ash cap material. This sequence of events formed a higher density sub-surface soil layer comprised of till or outwash material underneath a relatively unconsolidated and low bulk density surface layer of ash.

PHYSIOGRAPHIC AND CLIMATE FACTORS INFLUENCING INHERENT SOIL PRODUCTIVITY

Annual precipitation, elevation, aspect, and soil profile depths all directly influence the productivity of the soil resource and combine to provide a variety of vegetation plant associations within the subwatershed. Site potential and, in turn, the types of plant associations that occur within the subwatershed are strongly influenced by climate. As mean annual precipitation increases from low to mid elevations so does site productivity. At higher elevations precipitation continues to increase but lower mean annual temperatures and shorter growing seasons limit site productivity. Aspects are predominately easterly in nature and soil profile depths to bedrock range from very deep (60 inches +) to shallow (less than 12 inches). The combination of these factors provides primarily moderate and low inherent productivities with a lesser amount of high site class lands, predominantly at mid to upper elevations. Lands considered to be unsuited for timber management are present, including lands at higher elevations (generally within Wilderness) and lands on the eastern fringe of the Forest boundary (Soil Resource Inventory Map Unit #36). Table 14 provides a summary of the inherent productivity of the soil resource bases upon the cubic foot site class production figure associated with each Soil Resource Inventory Map unit.

Table 14: Inherent Productivity of the Soils in the Bull Creek Subwatershed

Productivity Class	Percent
High	13
Moderate	51
Low	30
Very Low	6
Totals	**100**

*Land type units from the NRCS Upper Deschutes Soil Survey that are mapped on private lands in the Lower Tumalo Creek sub-subwatershed to the east of the Deschutes National Forest boundary were correlated as best as possible with SRI land types in order to determine their productivity class for this summary.

EROSIONAL PROCESSES

Erosional processes were primarily surface in origin, although some slopes in the upper portions of the subwatershed are steep enough to have exhibited areas with landslides. Landforms and cyclic climatic patterns have in the past generated rain on snow and thunderstorm events that accumulate significant overland flows capable of eroding low cohesion material on the surface. Slope stability was primarily

influenced by the level of fire disturbance that had occurred in the years prior to a significant rainfall run-off event, most notably the extent of surface mineral soil exposed as a result of biomass consumption from fires. Although fire was a part of all plant associations present within the subwatershed, the frequency and behavior of these events varied enough to provide different degrees and extents of slope susceptibility to Erosional processes.

Natural fire cycles in the mixed conifer and mountain hemlock plant associations often lead to stand replacement fires capable of consuming the majority of live and dead organic matter on the soil surface. These conditions left bare mineral soil susceptible to wind and water erosion in the immediate years following a fire. These areas also coincide with some of the steepest slopes in the subwatershed, increasing the rate and extent of Erosional events when they did occur.

Fire cycles within the ponderosa pine plant associations were likely lower intensity fires that occurred at return intervals of 5 to 20 years on average. These types of fire events did not generally consume all of the organic cover on the soil surface and resulted in the exposure of less bare mineral soil following each event. Slopes in these areas are also more gradual and less susceptible to surface erosion.

CURRENT SOIL CONDTIONS

Since the last subwatershed analysis in 1998, no documented management activities have occurred within the subwatershed on Federal lands. There have been additional harvest activities that have occurred on private timber lands within the boundary of the Forest. Road density calculations reveal and extensive network of roads throughout the private forest land. Skid trail patterns and densities visible in photos support the occurrence of intensive ground based operations within the private lands. The soil resource has been impacted to varying degrees from these past management activities as a result of soil compaction, displacement, of surface organics, and loss of the mineral soil A horizon. The productivity of the soil resource, as a result of these conditions within highly disturbed areas, has been altered to some extent, although the majority of sites continue to support second growth forests and herbaceous vegetation.

HERITAGE

The heritage analysis is provided for the upper portion and the lower portion of the watershed. This is due to private lands separating the two areas.

The western, upper portion of the watershed has had little management over the years and, subsequently, very little investigation of heritage resources. Approximately 10% of the FS lands have been surveyed. Much of this limited past heritage work is due to approximately 2/3 of the upper part of the subwatershed consisting of either roadless area (2,770 acres) or wilderness (152 acres) where project work is generally does not occur.

Most of the survey work in this upper portion of the watershed was part of the Bearwallow Lodgepole Pine T.S. Surveys from 1992. Other small heritage surveys in the area include one of the California Energy Exploratory Wells (1989), a trail relocation project, and electronic sites on top of Triangle Hill and Bearwallow Butte. Currently, one site is recorded, the remains of an historic structure, likely a past lookout, on top of Triangle Hill (06010100428). This historic site is not adequately recorded and is unevaluated.

The eastern, lower part of this subwatershed, at the forest boundary bounded by private land on the east and west, has much more heritage investigation, approximately 50% having been surveyed. Much of the survey work occurred during the Crown Pacific Land Exchange in 1996. More recent surveys were done for the Tumbull Hazard Fuels Reduction in 2006 and the Rock Spring Trails in 2002. Two known heritage site are located in this lower portion: a large lithic scatter site (06010100559) and a ditch or canal site that is characterized as multi-component (historic and prehistoric, 06010100560). The lithic scatter site is evaluated as eligible and the ditch is unevaluated.

CHAPTER 4: TRENDS AND INTERPRETATION

FUELS			
TREND	**CAUSE**	**PROCESSES AFFECTED (ECOLOGICAL and SOCIAL)**	**RESOURCES AT RISK OR BENEFIT**
• Increased fuel loadings and increased risk of high intensity fires in PP, MCW, and MCD PAGs. • Increase in risk in high mortality areas in high elevation forests and lodgepole/mixed conifer • Shift from a complex moderate fire severity regime in all PP, MCW, and MCD PAGs. Fire sizes and intensities have been increasing in the PP and Juniper PAGs. Increased management to reduce fuels (mowing, thinning, burning, etc.) to lower wildfire risks and benefit fire evolved ecosystems	• Fire exclusion • High stand density • Increase in cheatgrass • Tree mortality from insects and disease	• Fire behavior/intensity • Natural succession • Age class distribution • Insect and disease susceptibility	• Late successional habitat and species • Dispersal habitat • Forest/urban interface areas and developments • Big game forage, esp. winter range • Firefighter/public safety
• Increase in human started fires throughout the watershed, especially near forest urban interface and recreation areas.	• Increased population growth and use • Urban interface development and use of public lands • Fire exclusion	• Fire behavior/intensity • Natural succession • Age class distribution • Insect and disease susceptibility	• Late successional habitat and species • Dispersal habitat • Big game forage, esp. winter range • Forest/urban interface areas and developments • Private forest lands • Firefighter/public safety

SILVICULTURE			
TREND	**CAUSE**	**PROCESSES AFFECTED (ECOLOGICAL and SOCIAL)**	**RESOURCES AT RISK OR BENEFIT**
• Increase in management may cause blow down in some lodgepole stands	• Timber harvest • Unit design and layout • Wind	• Fire behavior • Natural succession • Insect and disease susceptibility • Natural decay and recruitment	• Focal species for the lodgepole PAG • Soils
• Decrease in med/large tree structure in MCW, MCD, and PP PAGs. • Loss of old growth in lodgepole and high elevation forests due to mountain pine beetle	• Timber harvest • Fire exclusion • Mortality from insects and disease • Land ownership patterns	• Natural succession • Fire behavior • Reproductive success • Gene flow • Microclimate • Connectivity • Nutrient cycling	• NRF habitat for spotted owls, late successional species • Woodpecker habitat • Furbearer habitat • Loss of large wood input in forests
• Species composition has changed in MCD and MCW from pioneer species dominated stands to climax species dominated stands to white fir dominated stands. • Stand densities have increased and vertical structure is more complex in PP, MCW, MCD PAGs	• Fire exclusion • Timber Harvest	• Natural Succession • Reproductive Success • Fire Behavior • Predation • Microclimate • Loss of stand stability • Age class distribution • Insect and disease disturbance and	• Late successional species and habitats • Future nesting, roosting, and foraging habitat for spotted owls • DF and PP associated species, especially woodpeckers and

SILVICULTURE			
TREND	**CAUSE**	**PROCESSES AFFECTED (ECOLOGICAL and SOCIAL)**	**RESOURCES AT RISK OR BENEFIT**
• Juniper has increased in the PP PAG. • Increase in shrub component and decrease in grass and forb component		susceptibility • Disturbance processes	goshawks • Forest structure • Juniper/grassland habitat and associated species • Firefighter/public safety
• Decrease in old growth in Lodgepole and High Elevation PAGs. Increasing stand age diversity.	• Fire exclusion • Insect outbreak	• Fire behavior • Natural succession • Loss of stand stability • Insect and disease susceptibility • Prey base cycling	• Focal species for each PAG (i.e., black-backed woodpecker) • Tree encroachment on high elevation meadows
• Decrease in large snags • Increase in down woody material in lodgepole stands • Decrease in down woody in ponderosa stands	• Timber harvest • Firewood cutting • Mortality from insects	• Natural Succession • Reproductive Success • Fire Behavior • Predation • Microclimate • Natural decay and recruitment • Nutrient cycling	• Snag and log dependent species and nesting/denning habitat for woodpeckers, marten, fisher, etc.
• Decrease in Late successional species and increase in early and mid seral species	• Timber harvest • Fire exclusion • Urban interface	• Reproductive success • Predation	• Proposed, endangered, threatened, sensitive, and survey and manage species

WILDLIFE			
TREND	**CAUSE**	**PROCESSES AFFECTED (ECOLOGICAL and SOCIAL)**	**RESOURCES AT RISK OR BENEFIT**
• Increase in management may cause blowdown in some lodgepole stands	• Timber harvest • Unit design and layout	• Fire behavior • Natural succession • Insect and disease susceptibility • Natural decay and recruitment	• Focal species for the lodgepole PAG • Soils
• Landscape Patterns have changed in PP, MCD, and MCW PAGs. • Fragmentation and edge have increased • Patch size and connectivity have decreased (Loss of mixed conifer District wide)	• Timber Harvest • Fire exclusion • Roads • Increased Population Growth • Land Ownership Patterns • Conversion of agriculture lands to developments	• Natural Succession • Loss of Stand Stability • Age Class Distribution • Competition • Microclimate • Reproductive Success • Fire Behavior • Predation • Gene Flow • Migration	• Late successional and interior forest species and habitats • Dispersal ability of late successional species (spotted owls) • Neotropical migrant bird species • Low mobility species • Deer and elk security • Visual quality
• Species composition has changed in MCD and MCW from pioneer species dominated stands to climax species dominated stands to white fir dominated stands. • Stand densities have increased and vertical structure is more complex in PP, MCW, MCD PAGs • Juniper has increased in the PP PAG. • Increase in shrub component and decrease in grass and forb component	• Fire exclusion • Timber Harvest	• Natural Succession • Reproductive Success • Fire Behavior • Predation • Microclimate • Loss of stand stability • Age class distribution • Insect and disease disturbance and susceptibility	• Late successional species and habitats • Future nesting, roosting, and foraging habitat for spotted owls • DF and PP associated species, especially woodpeckers and goshawks • Forest structure • Juniper/grassland habitat and associated species • Firefighter/public safety
• Decrease in large snags • Increase in down woody material	• Timber harvest • Firewood cutting	• Reproductive Success • Predation	• Snag and log dependent species and

WILDLIFE			
TREND	**CAUSE**	**PROCESSES AFFECTED (ECOLOGICAL and SOCIAL)**	**RESOURCES AT RISK OR BENEFIT**
in lodgepole stands • Decrease in down woody in ponderosa stands	• LP mortality from insects	• Natural Succession • Fire Behavior • Natural decay and recruitment • Nutrient cycling	nesting/denning habitat for woodpeckers, marten, fisher, etc.
• Decrease in Late successional species and increase in early and mid seral species	• Timber harvest • Fire exclusion	• Reproductive success • Predation	• Proposed, endangered, threatened, sensitive, and survey and manage species
• Degradation and encroachment of meadows and special habitats	• Timber harvest • Fire exclusion	• Reproductive success • Predation • Fire behavior • Microclimate	• Great gray owl nest sites • Townsends big eared bats – cave vandalism
• Increase in exotic and non-native wildlife	• Timber harvest • Fire suppression • Urban interface	• Reproductive success • Genetic fitness • Predation	• Neotropical migrant bird species, spotted owl, woodpeckers
• Continued need for special forest products (firewood, etc.)	• Population growth • Management philosophy • Economy	• Food chain • Natural decay and recruitment • Nutrient cycling • Changing public desires and values	• Survey and manage species • Unique habitats • Decrease of large wood

ROADS			
TREND	**CAUSE**	**PROCESSES AFFECTED (ECOLOGICAL and SOCIAL)**	**RESOURCES AT RISK OR BENEFIT**
• Increased run-off due to roads • Decreased road maintenance	• Increase in compaction– changes infiltration rates • Decreasing budgets and money for maintenance	• Sediment delivery • Disruption of hydrologic process	• Wildlife habitat • Recreation traffic flow
• Increase in road densities – trend has peaked • Some unmaintained are closing themselves but need hydrological fix	• Timber harvest • Lack of road funding	• Successional patterns • Reproductive success of some species, Predation • Microclimate • Hydrologic process	• Wildlife/plant habitats • Hunting success • Heritage resources • Recreational experience

SOCIAL			
TREND	**CAUSE**	**PROCESSES AFFECTED (ECOLOGICAL and SOCIAL)**	**RESOURCES AT RISK OR BENEFIT**
• Increasing resident population • Increased tourism	• Population growth in Deschutes County along urban interface • Central Oregon popularity	• Fire ignitions • Reduction in habitat • Compaction, Degradation	• Sensitive habitats in popular destinations • Urban interface areas • Recreational experience • Heritage resources • Firefighter/public safety
• Current private land ownership allows for potential development, especially the conversion of farm and forest lands	• Increased population • Land ownership patterns	• Management options • Habitat connectivity • Migration • Fire behavior • Natural succession	• Urban interface areas • Forest habitat quality • Terrestrial wildlife and plant species and habitats • Fire suppression and costs
• Increased forest/developed urban interface • Increased Illegal dumping, OHV use	• Private lands adjacent to and surrounding DNF land • Increased population growth	• Fire behavior • Natural succession • Habitat connectivity • Conflicts with traditional uses (hunting and target practice)	• Heritage resources • Forest structure • Interior forest species • Large tree dependent species

SOCIAL			
TREND	**CAUSE**	**PROCESSES AFFECTED (ECOLOGICAL and SOCIAL)**	**RESOURCES AT RISK OR BENEFIT**
		• Migration • Reproductive success • Predation • Microclimate	• Big game forage and cover • Quality of life • Firefighter/public safety
• Increase in non-recreational forest camping/living	• Economy – lack of affordable housing • Population growth	• Erosion/Compaction • Vegetation growth and reproduction • Fire risk increase	• Recreational experience • Heritage resources • Wildlife/plant species and habitats
• Continued need for special forest products (firewood, etc.)	• Population growth • Management philosophy	• Natural decay and recruitment • Changing public desires and values	• Survey and manage species • Decrease of large wood
• Increased recreation day/dispersed use - horses, mountain bikes, OHVs, etc.	• Population growth • Improved access	• Infiltration • Erosion/Compaction • Noxious weed sites • Vegetation growth and reproduction • Reproductive success	• Heritage resources • Localized impacts to special habitats (subalpine areas, etc.) • Wildlife/plant species and habitats • Recreational experience
• Increase in wilderness trespass (i.e., snowmobile use, illegal digging of alpine plants, etc.)	• Inadequate signing of wilderness boundary • Lack of FS presence and recreational funding • Increased populations and public use	• Wildlife reproductive success, Genetic fitness • Migration/travel routes • Succession • Erosion	• Wolverine, fisher, marten and other high elevation species • Sensitive alpine habitats • Recreational experience

RECREATION			
TREND	**CAUSE**	**PROCESSES AFFECTED (ECOLOGICAL and SOCIAL)**	**RESOURCES AT RISK OR BENEFIT**
• Road use has changed from logging to recreation	• Reduced logging • Recreation population increase • Difficult to close roads	• Management options • Recreational funding does not support maintenance	• Wildlife/plant habitats • Spread of noxious weeds • Safety
• Recreation budgets have decreased	• General budget decline in Forest Service • Increased use of facilities	• Recreational experience	• Localized site damage • Quality of experience • Safety

BOTANY			
TREND	**CAUSE**	**PROCESSES AFFECTED (ECOLOGICAL and SOCIAL)**	**RESOURCES AT RISK OR BENEFIT**
• Increase in non-native plants, especially on private lands	• Weed spread along roads • Ground disturbance • Contaminated equipment and horse feed • Lack of weed control and enforcement on private lands	• Biodiversity • Natural succession	• Native plant and wildlife species and habitat

SCENIC			
TREND	**CAUSE**	**PROCESSES AFFECTED (ECOLOGICAL and SOCIAL)**	**RESOURCES AT RISK OR BENEFIT**
• Changes in USFS scenery	• People's expectations	• Natural processes are not always	• Management options

management philosophy to manage for ecological aesthetic	• Driving for pleasure	understood or accepted by public	• Forest ecology
• Degradation of scenic quality	• Fire exclusion • High tree mortality areas • Lack of big trees	• Fire behavior • Susceptibility to insects and disease • Connectivity	• Desired landscape character • Forest ecology

HERITAGE			
TREND	**CAUSE**	**PROCESSES AFFECTED (ECOLOGICAL and SOCIAL)**	**RESOURCES AT RISK OR BENEFIT**
• Loss of important heritage resource information through vandalism, removal of artifacts, development on private lands, and decomposition of wood and metal	• Increased recreational use • Increase in population growth	N/A	• Heritage resources • Culturally sensitive plants

TREND	CAUSE	PROCESSES AFFECTED (ECOLOGICAL and SOCIAL)	RESOURCES AT RISK
• Detrimental soil impacts, mainly soil compaction **Trend 1**	• Timber harvest • Roading	• Reduced soil productivity • Reduced seedling survival • Increased root disease associated with compaction • Reduced water infiltration rates in compacted areas	• Site productivity and tree growth • Wildlife habitat • Heritage resources • Scenic quality
• Increased run-off due to roads • Decreased road maintenance **Trend 2**	• Increase in compaction– changes infiltration rates • Decreasing budgets and money for maintenance	• Sediment delivery • Disruption of hydrologic process	• Wildlife habitat • Recreation traffic flow
• Increased fuel loadings and increased risk of high intensity fires in PP, MCW, and MCD PAGs. Shift from a complex moderate fire severity regime in all PP, MCW, and MCD PAGs. Fire sizes and intensities have been increasing in the PP and Juniper PAGs. **Trend 3** **increase in risk in high mortality areas in high elevation forests and lodgepole/mixed conifer**	• Fire exclusion • High stand density • Increase in cheatgrass • Tree mortality from insects and disease	• Fire behavior/intensity • Natural succession • Age class distribution • Insect and disease susceptibility	• Late successional habitat and species • Dispersal habitat • Forest/urban interface areas and developments • Big game forage, esp. winter range • Firefighter/public safety
• Increase in human started fires, especially in the PP PAG near forest urban interface **Trend 4** **Human caused fire starts have increased throughout the watershed**	• Increased population growth and use • Urban interface development and use of public lands • Fire exclusion	• Fire behavior/intensity • Natural succession • Age class distribution • Insect and disease susceptibility	• Late successional habitat and species • Dispersal habitat • Big game forage, esp. winter range • Forest/urban interface areas and developments • Private forest lands • Firefighter/public safety
• Increased management to reduce fuels (mowing, thinning, burning, etc.) to lower wildfire risks and benefit fire evolved ecosystems **Trend 5**	• Increased risk of extreme fire behavior • Desire to reintroduce fire	• Fire behavior/intensity • Natural succession • Age class distribution • Insect and disease susceptibility	• Late successional habitat and species • Dispersal habitat • Big game forage, esp. winter range

TREND	CAUSE	PROCESSES AFFECTED (ECOLOGICAL and SOCIAL)	RESOURCES AT RISK
			• Firefighter/public safety • Urban interface areas
• Increase in management may cause blowdown in some lodgepole stands **Trend 6**	• Timber harvest • Unit design and layout • Wind	• Fire behavior • Natural succession • Insect and disease susceptibility • Natural decay and recruitment	• Focal species for the lodgepole PAG • Soils
• Decrease in med/large tree structure in MCW, MCD, and PP PAGs **Trend 7** **Loss of old growth in lodgepole and high elevation forests due to mountain pine beetle**	• Timber harvest • Fire exclusion • Mortality from insects and disease • Land ownership patterns	• Natural succession • Fire behavior • Predation • Reproductive success • Gene flow • Microclimate • Connectivity • Nutrient cycling	• NRF habitat for spotted owls, late successional species • Woodpecker habitat • Furbearer habitat • Loss of large wood input in forests
• Landscape Patterns have changed in PP, MCD, and MCW PAGs. Fragmentation and edge have increased and patch size and connectivity have decreased. **Trend 8** **Loss of mixed conifer District wide has reduced connectivity**	• Timber Harvest • Fire exclusion • Roads • Increased Population Growth • Land Ownership Patterns • Conversion of agriculture lands to developments	• Natural Succession • Loss of Stand Stability • Age Class Distribution • Competition • Microclimate • Reproductive Success • Fire Behavior • Predation • Gene Flow • Migration	• Late successional and interior forest species and habitats • Dispersal ability of late successional species (spotted owls) • Neotropical migrant bird species • Low mobility species • Deer and elk security • Visual quality
• Species composition has changed in MCD and MCW from pioneer species dominated stands to climax species dominated stands to white fir dominated stands. • Stand densities have increased and vertical structure is more complex in PP, MCW, MCD PAGs • Juniper has increased in the PP PAG. • Increase in shrub component and decrease in grass and forb component **Trend 9**	• Fire exclusion • Timber Harvest	• Natural Succession • Reproductive Success • Fire Behavior • Predation • Microclimate • Loss of stand stability • Age class distribution • Insect and disease disturbance and susceptibility • Disturbance processes	• Late successional species and habitats • Future nesting, roosting, and foraging habitat for spotted owls • DF and PP associated species, especially woodpeckers and goshawks • Forest structure • Juniper/grassland habitat and associated species • Firefighter/public safety
• Increase in old growth in Lodgepole and High Elevation PAGs. Decreased stand age diversity. **Trend 10** **UPDATE-<u>Trend has reversed</u> due to high mortality. Now a decrease in old growth and beginning of an increase in stand age diversity.**	• Fire exclusion • Insect outbreak	• Fire behavior • Natural succession • Loss of stand stability • Insect and disease susceptibility • Prey base cycling	• Focal species for each PAG (i.e., black-backed woodpecker) • Tree encroachment on high elevation meadows
• Decrease in large snags • Increase in down woody material in lodgepole stands • Decrease in down woody in ponderosa stands **Trend 11**	• Timber harvest • Firewood cutting • Mortality from insects	• Natural Succession • Reproductive Success • Fire Behavior • Predation • Microclimate • Natural decay and recruitment • Nutrient cycling	• Snag and log dependent species and nesting/denning habitat for woodpeckers, marten, fisher, etc.

TREND	CAUSE	PROCESSES AFFECTED (ECOLOGICAL and SOCIAL)	RESOURCES AT RISK
• Decrease in Late successional species and increase in early and mid seral species **Trend 12**	• Timber harvest • Fire exclusion • Urban interface	• Reproductive success • Predation	• Proposed, endangered, threatened, sensitive, and survey and manage species
• Degradation/encroachment of meadows and special habitats **Trend 13**	• Fire exclusion • Timber harvest	• Reproductive success • Predation • Genetic fitness • Fire behavior • Microclimate	• Great gray owl nest sites • Townsends big eared bats – cave vandalism
• Increase in exotic and non-native wildlife **Trend 14**	• Timber harvest • Fire suppression • Urban interface	• Reproductive success • Genetic fitness • Predation	• Neotropical migrant bird species, spotted owl, woodpeckers
• Increase in non-native plants, especially on private lands **Trend 15**	• Weed spread along roads • Ground disturbance • Contaminated equipment and horse feed • Lack of weed control and enforcement on private lands	• Biodiversity • Natural succession	• Native plant and wildlife species and habitat
• Increasing resident population • Increased tourism **Trend 16**	• Population growth in Deschutes County along urban interface • Central Oregon popularity	• Fire ignitions • Reduction in habitat • Compaction, Degradation	• Sensitive habitats in popular destinations • Urban interface areas • Recreational experience • Heritage resources • Firefighter/public safety
• Changes in land use and ownership especially the conversion of farm and forest lands into developed lands **Trend 17**	• Increased population	• Habitat connectivity • Migration • Fire behavior • Natural succession	• Urban interface areas • Habitat quantity/quality • Terrestrial wildlife and plant species and habitats • Fire suppression
• Current land ownership allows for potential development. *This could change* **Trend 18**	• Land ownership patterns • Increasing growth	• Management options • Habitat connectivity	• Management costs • Forest habitats
• Increased forest/developed urban interface • Increased Illegal dumping, OHV use, trespass **Trend 19**	• Private lands adjacent to and surrounding DNF land • Increased population growth	• Fire behavior • Natural succession • Habitat connectivity • Conflicts with traditional uses (hunting and target practice) • Migration • Reproductive success • Predation • Microclimate	• Heritage resources • Forest structure • Interior forest species • Large tree dependent species • Big game forage and cover • Quality of life • Firefighter/public safety
• Continued need for special forest products (firewood, etc.) **Trend 20**	• Population growth • Management philosophy	• Food chain • Natural decay and recruitment • Nutrient cycling • Changing public desires and values	• Survey and manage species • Unique habitats • Decrease of large wood
• Increase in road densities – trend has peaked • Some unmaintained are closing themselves but need hydrological fix **Trend 21**	• Timber harvest • Lack of road funding	• Successional patterns • Reproductive success of some species, Predation • Microclimate • Hydrologic process	• Wildlife/plant habitats • Hunting success • Heritage resources • Recreational experience
• Road use has changed from logging to recreation **Trend 22**	• Reduced logging • Recreation population increase	• Management options • Recreational funding does not support maintenance	• Wildlife/plant habitats • Spread of noxious weeds • Safety

TREND	CAUSE	PROCESSES AFFECTED (ECOLOGICAL and SOCIAL)	RESOURCES AT RISK
	• Difficult to close roads		
• Increased recreation use - horses, mountain bikes, OHVs, etc. • Increased day/dispersed use **Trend 23**	• Population growth • Improved access	• Infiltration • Erosion/Compaction • Noxious weed sites • Vegetation growth and reproduction • Reproductive success	• Heritage resources • Localized impacts to special habitats (subalpine areas, etc.) • Wildlife/plant species and habitats • Recreational experience
• Increase in non-recreational forest camping/living **Trend 24**	• Economy – lack of affordable housing • Population growth	• Erosion/Compaction • Vegetation growth and reproduction	• Recreational experience • Heritage resources • Wildlife/plant species and habitats
• Increase in wilderness trespass (i.e., snowmobile use, illegal digging of alpine plants, etc.) **Trend 25**	• Inadequate signing of wilderness boundary • Lack of Forest Service presence and recreational funding • Increased populations and public use	• Reproductive success • Migration/travel routes • Succession • Erosion • Predation • Genetic fitness	• Wolverine, fisher, marten and other high elevation species • Sensitive alpine habitats • Recreational experience
• Changes in USFS scenery management philosophy to manage for ecological aesthetic **Trend 26**	• People's expectations • driving for pleasure	• Natural processes are not always understood or accepted by public	• Management options • Forest ecology
• Degradation of scenic quality **Trend 27**	• Fire exclusion • High tree mortality areas • Lack of big trees	• Fire behavior • Biodiversity • Insect and disease susceptibility • Connectivity	• Desired landscape character • Forest ecology
• Loss of important heritage resource information through vandalism, removal of artifacts, development on private lands, and decomposition of wood and metal **Trend 28**	• Increased recreational use • Increase in population growth		• Heritage resources • Culturally sensitive plants
• Recreation budgets have decreased **Trend 29**	• General budget decline in Forest Service • Increased use of facilities	• Recreational experience	• Localized site damage • Quality of experience • Safety

CHAPTER 5: SYNTHESIS

Four themes emerged while compiling information on the assessment area and these were used to identify potential future management opportunities.

ECOSYSTEM HEALTH

The area has been impacted by mountain pine beetle activity with high lodgepole pine mortality rates. Essentially, this is a stand replacement event, although there are lodgepole pine that have survived and regeneration of these stands is occurring.

Although the area is not critical habitat for TES species, it is important as a travel corridor and summer range for deer and elk. The roadless area and wilderness designations reduce the available management options that are available, in those areas. Implementing fuels reduction and stand density activities to the east of roadless would reduce the risk of high intensity fire and further insect epidemic tree mortality.

FIRE AND FUELS

The analysis suggests that the potential for extreme fire behavior associated with current and future accumulations is high. Standing dead trees (primarily beetle killed lodgepole pine) should begin to fall in large numbers within the next 4-6 years. As a result, the fuel loading will substantially increase, increasing the risk of a high intensity fire. Because of this, there is an associated risk to public and fire fighter safety and fire burning onto private lands. One-half of the fires started in the assessment area from 1981-2002 were human caused. Within the next decade, modeled fire behavior suggests a change from passive crown fire to active crown fire, and the potential for this type of extreme fire behavior will exist for at least 20 years without treatment (BWT WA). This potential to burn uncontrolled creates a high risk to firefighters and the public. Any fire could be less intense when reaching Skyline Forest in the areas that have been treated in the past and potentially controlled prior to reaching those areas that are inhabited near Tumalo Reservoir.

Those areas that have heavy fuel loading outside of the Wilderness and IRA have the opportunity to be salvage harvested to reduce fuel loading. Salvage harvesting to reduce fuels within the IRA would be cost prohibitive outside of the travel corridors where removing standing dead trees would be for the purpose of public safety.

WILDLAND URBAN INTERFACE

The city of Bend and the surrounding communities and developments have experienced large population growth. Growth has presently stabilized, in large part as a result of the downturn in the economy. There has been a mixed forecast regarding an upswing in the local economy and potential population growth. With Bend being such a desirable area to live, it is expected that this area could begin to experience growth before many areas of Oregon when the economy begins to recover.

A portion (30,000 of 33,000 acres) of Skyline Forest is in the process of being purchased. It is expected that most of this land will be managed in a manner that is consistent with the Federal lands. As an agreement, approximately 3,000 acres of the western-most portion closest to Sisters would be retained by the private land owner with approximately 1,600 acres to be potentially developed. The DNF adjacent to the western boundary of Skyline Forest has heavy tree mortality. This area has the opportunity for treatments to reduce tree density and fuels loading to reduce the risk of stand replacement wildfire and the movement of fire onto the private lands. Any treatment would not reduce the complete risk of wildfire from FS to private lands, although there would be substantial fragmentation of fuels and reduction of risk.

Recreational use that originates from private land would not be expected to be affected to any great extent. Current uses would continue with some changes for those that presently utilize deer habitat during those times of seasonal closure.

DEER HABITAT

The narrow band of Deer Habitat is located between Skyline Forest on the west and other private lands to the east. This area is to provide refuge and fawning habitat during the winter months. This area is fragmented with several roads that run east-west. Recreational OHV and driving for pleasure are likely the most active use of this area. These uses can actively disrupt deer during the time of year that is most important for maintaining energy reserves.

Reducing fire risk to this area is important to maintain habitat. Risk reduction within and outside of Deer Habitat could not only reduce the risk of loss of habitat but could increase optimum habitat conditions regarding hiding cover and forage/browse plant species.

CHAPTER 6: MANAGEMENT RECOMMENDATIONS, DATA GAPS/ANALYSIS LIMITATIONS, MONITORING AND OPPORTUNITIES

MANAGEMENT RECOMMENDATIONS

Management recommendations are made by the watershed analysis team as a way to maintain and protect the critical elements and processes identified through the trend ratings and assessment of ecological conditions in Chapter V. Using the issues and the key questions, these recommendations reflect the most relevant and desirable conditions for the watershed which are the protection of water quality, enhancement of a quality recreation experience, and improvement of forest health and riparian function.

WILDERNESS

- Manage natural ignitions for the benefit of natural resources (Wildland Fire Use) in accordance with the Cascade Crest Wildland Fire Use Guide (2008).
- Determine appropriate level of use for this landscape area.
- Maintain current maintenance level (Level 2) and seasonal closures on Road 370 to limit access, improve safety for users, and reduce impacts to resources due to road deterioration.
- Assess appropriate recreation use levels to limit social and resource impacts.

FRONT COUNTRY/TRANSITION

- Reduce stand densities and fuel loading where appropriate. Use CWPP's for design of projects to reduce hazardous fuels adjacent to Fidelity lands and restore fire resilient stands.
- Improve public safety through hazardous fuels reduction, including along access routes.
- Thin and culture to develop late structure and prevent overstocking in the ponderosa pine and mixed conifer dry sites.
- Salvage some of the standing and down dead in higher elevation lodgepole pine for fuel reduction to reduce fire risk while retaining overstory continuity.

DRY FOREST

- Road density reduction through closure and obliteration.
- Mowing and burning to treat shrub component.
- Assess road to trail conversion opportunities and existing use trail tread design and restriction status of any trails acquired through the Crown Land Exchange.
- Re-introduce fire in appropriate stands to address urban interface fire protection/awareness needs.
- Thin and culture in high density, late and old structural ponderosa pine and mixed conifer dry sites.

WILDLIFE

- Conduct surveys for the threatened northern spotted owl and Regional Forester Sensitive Species, particularly at unique habitats such as the springs and ponds in the watershed.
- Open road densities are at LRMP thresholds. Evaluate the potential for road closures and road decommissioning to increase habitat security for deer and elk.

DATA GAPS AND ANALYSIS LIMITATIONS

SOILS

- The extent of detrimental soil conditions is a very coarse estimate. No field validation or monitoring has occurred. Soil sampling is needed for verification..
- Soil restoration associated with compaction from past mechanized harvest operations should occur in upland areas within the Bull Creek drainage, especially if forestlands are acquired by the Forest Service from private holdings that have experienced recent forest management. Activity areas identified as being in condition Class C or D under the existing condition analysis are included in these recommendations.
- The appropriate use and maintenance levels of roads need to be assessed at the project level in order to reduce resource impacts which are currently occurring as a result of erosion and sedimentation.

PRIVATE/DRY FOREST

Cascade Timberlands, Fidelity Land unknowns:

- Current Vegetation information/conditions.
- Past harvest, thinning, fuels activities.
- Road density.
- Recreation use.

RECREATION

Never completed:

- Rock Springs Guest Ranch Trail Condition Survey
- RSGR INFRA Trails

Prior to 2006:

- Dispersed Camping Inventories

HERITAGE

Data Gaps – This area either contains or is close to a basalt quarry site and has a high potential for glaciated basalt/andesite cobbles to be secondarily deposited throughout the area. A northern tributary or fork of Bearwallow Creek is a high probability area that has not been previous surveyed. No survey has been conducted at the several ponds in the western end of the subwatershed in the roadless area and wilderness portions of the subwatershed and they are also high probability areas.

WILDLIFE

Limited surveys for the species considered in this report in the Bull Creek subwatershed have occurred; therefore, knowledge of abundance and distribution of the species considered is inadequate. The amount and timing of surface water flow in the watershed in the riparian and seeps/ponds are not known.

MONITORING

SOILS

Monitoring of resource conditions along trail corridors needs to continue in order to track impacts that are a result of use or management designations.

WILDLIFE

The water flow in the riparian areas and at the springs should be evaluated for wildlife benefit and the recreational use at these sites monitored. Opportunities may occur for reducing impacts at these sites. Encroachment into wet meadows should also be evaluated and whether vegetation removal is warranted, taken into account impacts to the Sensitive species that could occur.

For potential firewood areas that occur adjacent to or near spotted owl habitat, firewood collection should be monitored by the Forest Service so that tree and snag species needed by spotted owls are not removed illegally.

Monitor the Tumalo Deer Winter Closure area in Deer Habitat to reduce disturbance to deer and elk during winter.

OPPORTUNITIES

FIRE/FUELS

Various Mechanical Treatments to Reduce Fuels

Areas of concern for WUI include the Skyliners community and proposed development on private lands east of the assessment area. The Roadless designation would not prohibit any of the following treatments on the majority of the assessment area. The treatments listed below could create fuel breaks if planned appropriately. Areas of opportunity would include roadside or residential fuel reductions on adjacent lands.

- **Chipping/bio-fuel:** Treatment option for small diameter and low quality trees. This practice would reduce fuel loading. Local and regional co-generation energy plants would utilize the commercial product. Community acceptance of green power opportunities could encourage the use of this practice.
- **Commercial or private fire wood collection:** Administer permits for collection of predetermined tree sizes, wood volume, and harvest location. Commercial product would be sold locally and fuel loading would be reduced in strategic locations.
- **Post and Pole Production:** Administer permits for collection of predetermined tree sizes, wood volume, and harvest location. Collection of higher quality valued timber would generate increased revenue compared to other practices. Post and Pole would leave low quality/low value material in the stand, potentially requiring additional fuel reduction treatments.
- **Masticate/Mow:** Mastication will mitigate ladder fuel accumulation. No commercial product will be produced but low operational cost makes this a potentially cost effective treatment. Residual fuels onsite will provide nutrient and moisture retention. Vertical fuels continuity will be disrupted thus reducing the potential for crown fire activity. The Roadless designation does not interfere with this treatment.

Fire for Resource Benefit

The use of fire within the watershed, whether ignited naturally or by humans, is severely limited by current air quality standards. Currently there are multiple airsheds that are strictly regulated by the Clean Air Act and a State designation of Bend and Redmond as Smoke Sensitive Receptor Areas (SSRAs). Working within these regulations will continue to challenge managers. A common misconception is that the Wilderness Class I designation is the most limiting air quality issue. The State designation of the SSRA is the most constraining factor for fuels management with regard to smoke. Regardless of the circumstances and challenges faced by fire management, it is necessary to address the critical issues regarding the threat of wildfire and its relation to WUI protection.

- There is currently a plan being developed to address planned management ignition in the Wilderness areas on the Deschutes National Forest. The Management Ignited Prescribed Fire in the Wilderness Plan is currently being analyzed. There are no provisions that allow fires to move across wilderness boundaries onto adjacent National Forest lands. Opportunities would present themselves if fire managers could find a way to include a provision in the plan allowing for fire ignited by management in the wilderness to move onto non-wilderness lands administered by the Forest Service. This provision could be an appropriate management response if smoke considerations are addressed and public support is acquired.
- Due to the substantial smoke limitations in the area of Bend, the use of human ignited prescribed fire and WFU is limited in scope in the assessment area. The drainages adjacent to the assessment area would funnel smoke into Bend at night. With these constraints, burning could be limited to pile ignition of fuels that were treated in proposed fuel break projects. It is important to note that the Class I airshed and SSRA constraints do not exclude prescribed fire or fire for resource benefit. However, public support for both prescribed fires and fires for resource benefit is essential

SCENIC

The project area has a risk of high intensity wildfire due to tree mortality from insects. There are opportunities to enhance scenic views especially in areas that are highly visible from Highway 20 between Sisters and Bend. There are currently large areas of private land adjacent to Forest Service lands with openings that appear unnatural and are seen as straight lines from Highway 20. By feathering trees and creating more of a random tree pattern in open areas along boundary lines, an opportunity exists to create an appearance of more natural occurring openings. Other locations throughout the project area in Front Country Seen Management Areas should also receive treatments resulting in natural appearing openings or shapes when viewed from Highway 20.

APPENDICES

APPENDIX A – WILDLIFE SPECIES, HABITAT, PRESENCE

Table 15: Federally Threatened, Endangered, and Candidate Wildlife Species, Habitat, and Presence

FEDERALLY THREATENED, ENDANGERED, AND CANDIDATE (PROPOSED)				
Species	**Status**	**Nature Serve Ranking**	**Habitat**	**Habitat/Presence in Watershed**
Northern Spotted Owl (*Strix occidentalis caurina*)	Threatened, MIS	S3	Old growth mixed conifer forests	Suitable NRF and dispersal habitat; presence unknown
Gray wolf (*Canis lupus*)	**Federal Endangered, Sensitive**	**SH**	**Any Forest PAG**	**Potential dispersal habitat**
Pacific Fisher (*Martes pennanti*)	Candidate, Sensitive	S2	Mixed coniferous forest with high canopy cover	Suitable habitat
Oregon Spotted Frog (*Rana pretiosa*)	Candidate	S2	Stream, marsh	No habitat or presence
Columbia spotted frog (*Rana luteiventris*)	Federal Candidate, Sensitive	S2S3	Shallow margins of lakes and ponds	No habitat or presence
Greater sage grouse (*Centrocercus urophasianus)*	Candidate, Sensitive	S3	Sagebrush	No habitat or presence
Wolverine (*Gulo gulo*)	Candidate, MIS	S2	High elevation lodgepole and mixed conifer	Suitable habitat; presence unknown

Table 16: Regional Forester Sensitive Wildlife Species

REGIONAL FORESTER SENSITIVE SPECIES				
Species	**Status**	**Nature Serve Ranking**	**Habitat**	**Habitat/Presence in Watershed**
BIRDS				
Northern bald eagle (*Haliaeetus leucocephalus*)	Sensitive, MIS	S4B, S4N	Lakeside or riverside with large trees	No habitat on Forest land. Habitat in watershed east of Forest boundary.
American peregrine falcon (*Falco peregrinus*)	Sensitive, MIS, BCC	S2B	Riparian, cliffs	No habitat.
Lewis' woodpecker (Melanerpes lewisi)	**Sensitive, MIS, BCC, Landbird Focal Species**	**S2, S3B**	**Open ponderosa pine forests, large diameter dead or dying trees, burned forests**	**Potential habitat**
White-headed woodpecker (*Picoides albolarvatus*)	**Sensitive, MIS, BCC, Landbird focal species**	**S2, S3**	**Mature ponderosa pine forests; weak excavator**	**Potential habitat**
Bufflehead (*Bucephala albeola*)	Sensitive, MIS	S2B, S5N	Lakes, snags	No habitat on Forest lands in the watershed. Documented occurrence at Tumalo Reservoir in the watershed on private lands east of the Forest boundary.
Northern waterthrush (*Seiurus noveboracensis)*	Sensitive	S2B	Riparian streambanks with dense willows for nesting	No habitat
Harlequin Duck (*Histrionicus histrionicus*)	Sensitive, MIS	S2B,S3N	Rapid streams, Large trees	No habitat
Horned Grebe (*Podiceps auritus*)	Sensitive, MIS	S2B, S5N	Lake	No habitat on Forest lands in the watershed. Potential habitat at Tumalo Reservoir in the watershed on private lands east of the Forest boundary.
Red-necked Grebe (*Podiceps*	Sensitive, MIS	S1B, S4N	Lake	No habitat on Forest lands in

REGIONAL FORESTER SENSITIVE SPECIES				
Species	**Status**	**Nature Serve Ranking**	**Habitat**	**Habitat/Presence in Watershed**
gisegena)				the watershed. Potential habitat at Tumalo Reservoir in the watershed on private lands east of the Forest boundary.
Tricolored Blackbird (*Agelaius tricolor*)	Sensitive	S2B	Lakeside, bulrush (cattails)	No habitat on Forest lands in the watershed. Potential habitat at Tumalo Reservoir in the watershed on private lands east of the Forest boundary.
Yellow Rail (*Coturnicops noveboracensis*)	Sensitive	S1B	Marsh	No habitat on Forest lands in the watershed. Potential habitat at Tumalo Reservoir in the watershed on private lands east of the Forest boundary. No documentation on the Forest. Closest population is Klamath Falls.
Tule greater white-fronted goose (*Anser albifrons elgasi*)	Sensitive	SNA	Nests on marshy ponds in tundra; winters in open country in shallow fresh or salt water Potential stopover (migration) habitat on the Forest.	No habitat on Forest land. Potential habitat at Tumalo Reservoir in the watershed on private land east of Forest boundary.
MAMMALS				
Gray wolf (*Canis lupus*)	**Federal Endangered, Sensitive**	**SH**	**Any Forest PAG**	**Potential dispersal habitat**
California wolverine (*Gulo gulo*)	**Federal Candidate, Sensitive**	**S2**	**Mixed conifer habitat, high elevation**	**Potential habitat; presence unknown.**
Townsend's big-eared bat (*Corynorhinus townsendii*)	Sensitive, MIS	S2	Caves, structures, lava rock, ponderosa pine forests	No cave habitat; low potential for foraging
Pallid bat (*Antrozous pallidus*)	Sensitive	S2	Caves, cliffs, rock outcrops, arid lands	Potential habitat
Spotted bat (*Euderma maculatum*)	Sensitive	S2	Cliffs, caves, rock outcrops, arid lands	No habitat
Fringed myotis (*Myotis thysanodes*)	Sensitive	S2	Cliffs, caves rock outcrops, arid lands	Potential habitat
AMPHIBIANS				
Oregon spotted frog (*Rana pretiosa*)	Federal Candidate, Sensitive	S2	Shallow margins of lakes and ponds	No habitat
Columbia spotted frog (*Rana luteiventris*)	Federal Candidate, Sensitive	S2S3	Shallow margins of lakes and ponds	No habitat
INVERTEBRATES				
Crater Lake tightcoil (*Pristiloma arcticum crateris*)	Sensitive	S1	Perennial streams with high canopy cover	No habitat
Silver-bordered fritillary (*Boloria selene*)	**Sensitive**	**S2**	**Wet meadows, bogs, and marshes**	**Not documented on the Forest. Potential habitat at springs and ponds; presence unknown.**
Johnson's hairstreak (*Calophrys johnsoni*)	**Sensitive**	**S2**	**Mistletoe in coniferous forests, especially old-growth**	**Potential habitat; presence unknown**
Evening field slug (*Deroceras*	**Sensitive**	**Not ranked**	**Perennial wet meadows**	**Not documented on the**

REGIONAL FORESTER SENSITIVE SPECIES				
Species	**Status**	**Nature Serve Ranking**	**Habitat**	**Habitat/Presence in Watershed**
***hesperium*)**				**Forest. Potential habitat at springs and ponds; presence unknown.**
Western bumblebee (*Bombus occidentalis*)	**Sensitive**	**Not ranked**	**Wet meadows, prairies, gardens in developments/urban areas**	**Not documented on the Forest. No habitat.**
NORTHWEST FOREST PLAN SURVEY AND MANAGE				
Great gray owl (*Strix nebulosa*)	MIS	S3	Mature and old growth forests with openings and meadows near water	No habitat
Crater Lake tightcoil (*Pristiloma arcticum crateris*)	Sensitive	S1	Perennial streams with high canopy cover	No habitat

*S1=Critically Imperiled; S2=Imperiled; S3=Vulnerable; S4=Apparently Secure; S5=Secure
B=Breeding; N=Non-Breeding; SHB=Possibly Extirpated-Breeding; SNA=Not Applicable

Table 17: Deschutes National Forest Management Indicator Species and Habitat

DESCHUTES LRMP MANAGEMENT INDICATOR SPECIES AND HABITATS				
Species	**Status**	**Nature Serve Ranking**	**Habitat**	**Habitat/Presence in Allotment**
BIRDS				
Golden eagle (*Aquila chrysaetos*)	MIS, BCC	S4	Large open areas with cliffs and rock outcrops	No habitat on Forest land. Potential habitat east of Forest boundary.
Red-tailed hawk (*Buteo jamaicensis*)	**MIS**	**S5**	**Large snags, open country interspersed with forests**	**Potential habitat**
Northern goshawk (*Accipiter gentilis*)	**MIS**	**S3B**	**Mature and old-growth forests; especially high canopy closure and large trees**	**Potential habitat**
Cooper's hawk (*Accipiter cooperi*)	**MIS**	**S4**	**Similar to goshawk, can also use mature forests with high canopy closure/tree density**	**Potential habitat**
Sharp-shinned hawk (*Accipiter striatus*)	**MIS**	**S4**	**Similar to goshawk in addition to young, dense, even-aged stands**	**Potential habitat**
Osprey (*Pandion haliaetus*)	MIS	S4	Large snags associated with fish bearing water bodies	No habitat on Forest land. Documented occurrence on private lands east of Forest boundary.
Great gray owl (*Strix nebulosa*)	MIS	S3	Mature and old growth forests associated with openings and meadows	Low potential for nesting habitat.
Woodpeckers[1]	**MIS**		**Mature to old-growth mixed conifer forests**	**Potential habitat; presence known**
Great blue heron (*Ardea Herodias*)	MIS	S4	Riparian edge habitats including lakes, streams, marshes and estuaries	No suitable habitat on Forest lands in watershed. Documented occurrence at Tumalo Reservoir in the watershed on private lands east of the Forest boundary.
Waterfowl[2]	MIS		Riparian edge habitats including lakes, streams, marshes and estuaries	No suitable habitat on Forest lands in watershed. Documented occurrence at Tumalo Reservoir in the watershed on private lands east of the Forest boundary.

DESCHUTES LRMP MANAGEMENT INDICATOR SPECIES AND HABITATS				
Species	**Status**	**Nature Serve Ranking**	**Habitat**	**Habitat/Presence in Allotment**
MAMMALS				
Rocky Mountain Elk (*Cervus elaphus*)	**MIS**	**S5**	**Mixed habitats**	**Existing habitat**
Mule deer (Odocoileus hemionus)	**MIS**	**S5**	**Mixed habitats**	**Existing habitat**
American marten (*Martes americana*)	**MIS**	**S3, S4**	**Mixed conifer or high elevation late-successional forests with abundant down woody material**	**Potential habitat**
HABITATS				
Snags and Downed Wood associated species and habitat	**MIS**		**Snags and down woody material**	**Existing habitat for woodpeckers, bats, and American marten**
Species Associated with Special or Unique Habitats	MIS		Springs, Seeps, cliffs, and talus slopes	No habitat

[1] Woodpecker and waterfowl species listed in Appendix 3.
*S1=Critically Imperiled; S2=Imperiled; S3=Vulnerable; S4=Apparently Secure; S5=Secure
B=Breeding; N=Non-Breeding; SHB=Possibly Extirpated-Breeding; SNA=Not Applicable

Table 18: MIS Woodpeckers

WOODPECKERS				
Species	**Status**	**Nature Serve Ranking**	**Habitat**	**Habitat and presence in watershed**
Pileated woodpecker (*Dryocopus pileatus*)	**MIS**	**S4**	**Large-diameter mixed conifer habitat**	**Potential habitat**
White-headed woodpecker (*Picoides albolarvatus*)	**Sensitive, MIS**	**S2, S3**	**Large-diameter ponderosa pine**	**Potential habitat**
Lewis's woodpecker (*Melanerpes lewis*)	**Sensitive, MIS**	**S2**	**Burned ponderosa pine**	**Potential habitat**
Northern flicker (*Colaptes auratus*)	**MIS**	**S5**	**Variety of forest types but more associated with forest edges**	**Potential habitat**
Hairy woodpecker (*Picoides villosus*)	**MIS**	**S4**	**Mixed conifer and ponderosa pine forests**	**Potential habitat**
Downy woodpecker (*Picoides pubescens*)	**MIS**	**S4**	**Riparian hardwood forest**	**Potential habitat**
Black-backed woodpecker (*Picoides auritus*)	**MIS, Landbird focal species**	**S3**	**Lodgepole pine forests, burned forests**	**Potential habitat**
American three-toed woodpecker (*Picoides dorsalis*)	**MIS**	**S3**	**High elevation and lodgepole pine forests**	**Potential habitat**
Red-naped sapsucker (*Sphyrapicus nuchalis*)	**MIS, Landbird focal species**	**S4**	**Riparian hardwood forests**	**Potential habitat**
Williamson's sapsucker (*Sphyrapicus thyroideus*)	**MIS, BCC, Landbird focal species**	**S4B,S3N**	**Mature or old growth conifer forests with open canopy cover; weak excavator**	**Potential habitat**

Table 19: MIS Waterfowl

WATERFOWL				
Species	**Status**	**NatureServe Ranking**	**Habitat**	**Habitat and Presence in watershed**
Common loon	MIS	SHB, S5N	Edges of remote freshwater ponds and lakes	No habitat on Forest land. Potential habitat Tumalo Reservoir private land in watershed east of Forest boundary
Pied-billed grebe	MIS	S5	Edge of open water in freshwater lakes, ponds, sluggish rivers and marshes	Same as above
Horned grebe	Sensitive, MIS	S2B, S5N	Lakes and ponds in forested areas	Same as above
Red-necked grebe	Sensitive, MIS	S1B, S4N	Lakes and ponds in forested areas	Same as above
Eared grebe	MIS	S4	Open water with emergent vegetation	Same as above
Western grebe	MIS	S3B, S2S3N	Marches with open water and lakes and reservoirs with emergent vegetation	Same as above
Canada goose	MIS	S5	Variety of habitat: shores of lakes, rivers, and reservoirs especially with cattails and bulrushes	Same as above
Wood duck	MIS	S4	Cavity nester, streams, ponds	Same as above
Gadwall	MIS	S5	Concealed clumps of grasses in meadows and tall grasslands	Same as above
American widgeon	MIS	N5B, N5N	Clumps of grasses in meadows or tall grasslands	Same as above
Mallard	MIS	S5	Open water with emergent vegetation	Same as above
Blue-winged teal	MIS	S4	Marshes, lakes, ponds, slow-moving streams	Same as above
Cinnamon teal	MIS	S5	Cover of vegetation near shoreline	Same as above
Northern shoveler	MIS	S5	Grassy areas near water	Same as above
Northern pintail	MIS	S5	Open areas near water	Same as above
Green-winged teal	MIS	S5	Freshwater marshes with emergent vegetation	Same as above
Canvasback	MIS	S4	Emergent vegetation	Same as above
Redhead	MIS	S4	Freshwater marshes and lakes concealed in vegetation	Same as above
Ring-necked duck	MIS	S3	Thick emergent vegetation on shorelines	Same as above
Lesser scaup	MIS	S3B, S3N	Dry grassy areas near lakes at least 10 ft. deep	Same as above
Common goldeneye	MIS	S4	Cavity nester, lakes	Same as above
Barrow's goldeneye	MIS	S3B,S3N	Cavity nester, lakes	Same as above
Bufflehead	Sensitive, MIS	S2B,S5N	Large-diameter trees and snags surrounding lakes	Same as above
Harlequin duck	Sensitive, MIS	S2B, S3N	Loafing sites in rivers	No habitat in watershed.
Hooded merganser	MIS	S4	Cavity nester, lakes	No habitat on Forest land. Potential habitat Tumalo Reservoir

WATERFOWL				
Species	**Status**	**NatureServe Ranking**	**Habitat**	**Habitat and Presence in watershed**
				private land in watershed east of Forest boundary.
Common merganser	MIS	S4	Cavity nester, streams, lakes	Same as above
Ruddy Duck	MIS	S4	Freshwater marshes, lakes, ponds in dense vegetation	Same as above

*S1=Critically Imperiled; S2=Imperiled; S3=Vulnerable; S4=Apparently Secure; S5=Secure
B=Breeding; N=Non-Breeding; SHB=Possibly Extirpated-Breeding; SNA=Not Applicable

Table 20: DecAID Distribution of Snags and Down Wood by Tolerance Intervals

Appendix 4. DecAID Distribution of snags and down wood by tolerance intervals

Williamson's sapsucker

Distribution of snags by Tolerance intervals for Williamson's Woodpecker for Forest														
	% of Nesting Habitat for Snags ≥ 10" dbh						**% of Nesting Habitat for Snags ≥ 20" dbh**							
Tolerance Interval	**0**	**0-30%**	**30-50%**	**50-80%**	**80%+**		**0**	**0-30%**	**30-50%**	**50-80%**	**80%+**			
Snags/Acre	**0**	**0-14**	**14-28.4**	**28.4-49.7**	**49.7+**		**0**	**0-3.3**	**3.3-8.6**	**8.6-16.6**	**16.6+**			
Forest Total	34%	52%	10%	3%	1%		53%	34%	10%	3%	0%			

Distribution of snags by Tolerance intervals for Williamson's sapsucker for Snags ≥ 20" dbh by Subwatershed														
% of Nesting Habitat		**Nesting Acres**							**% of Nesting Habitat**					
	6th Field Subwatershed	**Tolerance Interval**	**0**	**0-30%**	**30-50%**	**50-80%**	**80%+**	**Total Acres**	**0**	**0-30%**	**30-50%**	**50-80%**	**80%+**	
		Snags/Acre	**0**	**0-3.3**	**3.3-8.6**	**8.6-16.6**	**16.6+**		**0**	**0-3.3**	**3.3-8.6**	**8.6-16.6**	**16.6+**	**Total**
0%	Bull Creek		236	340	110	1		688	34%	49%	16%	0%	0%	100%

Distribution of snags by Tolerance intervals for Williamson's Woodpecker for Snags ≥ 10" dbh by Subwatershed														
% of Nesting Habitat		**Nesting Acres**							**% of Nesting Habitat**					
	6th Field Subwatershed	**Tolerance Interval**	**0**	**0-30%**	**30-50%**	**50-80%**	**80%+**	**Total Acres**	**0**	**0-30%**	**30-50%**	**50-80%**	**80%+**	
		Snags/Acre	**0**	**0-3.3**	**3.3-8.6**	**8.6-16.6**	**16.6+**		**0**	**0-3.3**	**3.3-8.6**	**8.6-16.6**	**16.6+**	**Total**
0.3%	Bull Creek		13	279	384	10	2	688	2%	41%	56%	1%	0%	100%

White-headed woodpecker

Distribution of snags by Tolerance intervals for White-headed woodpecker for Forest														
	% of Nesting Habitat for Snags ≥ 10" dbh						**% of Nesting Habitat for Snags ≥ 20" dbh**							
Tolerance Interval	**0**	**0-30%**	**30-50%**	**50-80%**	**80%+**		**0**	**0-30%**	**30-50%**	**50-80%**	**80%+**			
Snags/Acre	**0**	**0-0.4**	**0.4-2**	**2-4**	**4+**		**0**	**0.5**	**0.5-1.8**	**1.8-3.8**	**3.8+**			
Forest Total	51%	1%	19%	8%	21%		74%	2%	12%	4%	7%			

Distribution of snags by Tolerance intervals for White-headed woodpecker for Snags ≥ 20" dbh by Subwatershed														
		Nesting Acres by Subwatershed							**% of Nesting Habitat**					
% of Nesting Habitat	**6th Field Subwatershed**	**Tolerance Interval**	**0**	**0-30%**	**30-50%**	**50-80%**	**80%+**	**Total Acres**	**0**	**0-30%**	**30-50%**	**50-80%**	**80%+**	
		Snags/Acre	**0**	**0.5**	**0.5-1.8**	**1.8-3.8**	**3.8+**		**0**	**0.5**	**0.5-1.8**	**1.8-3.8**	**3.8+**	**Total**
0%	**Bull Creek**		4					4	100%	0%	0%	0%	0%	100%

Distribution of snags by Tolerance intervals for White-headed woodpecker for Snags ≥ 10" dbh by Subwatershed														
% of Nesting Habitat		**Nesting Acres**							**% of Nesting Habitat**					
	6th Field Subwatershe	**Tolerance Interval**	**0**	**0-30%**	**30-50%**	**50-80%**	**80%+**	**Total Acres**	**0**	**0-30%**	**30-50%**	**50-80%**	**80%+**	

	d	Snags/Acre	0	0-0.4	0.4-2	2-4	4+		0	0-0.4	0.4-2	2-4	4+	Total
0%	Bull Creek													
Three-toed woodpecker														
Distribution of snags by Tolerance intervals for Three-toed Woodpecker for Snags ≥ 10" dbh by Subwatershed														
% of Nesting Habitat			**Nesting Acres**						**% of Nesting Habitat**					
		Tolerance Interval	**0**	**0-30%**	**30-50%**	**50-80%**	**80%+**	**Total Acres**	**0**	**0-30%**	**30-50%**	**50-80%**	**80%+**	
	6th Field Subwatershed	**Snags/Acre**	**0**	**0-2.5**	**2.5-13.6**	**13.6-29.2**	**29.2+**		**0**	**0-2.5**	**2.5-13.6**	**13.6-29.2**	**29.2+**	**Total**
0.2%	Bull Creek		79	8	342	50	207	685	12%	1%	50%	7%	30%	100%
Distribution of Down Wood by Tolerance Intervals for Three-toed Woodpecker for Downwood≥ 5" dbh by Watershed														
% of Nesting Habitat	**Nesting Acres**								**% of Nesting Habitat**					
	Tolerance Interval	**0**	**0-30%**	**30-50%**	**50-80%**	**80%+**	**Total Acres**		**0**	**0-30%**	**30-50%**	**50-80%**	**80%+**	
	% Down Wood Cover	**0**	**0-6.5**	**6.5-17**	**17-32**	**32+**			**0**	**0-6.5**	**6.5-17**	**17-32**	**32+**	**Total**
Down Wood for Three-Toed Woodpecker														
Tolerance Levels (t.l.)														
Table EMC_S/L.sp-24, LP_S/L.sp24, MMC_S.sp-24 and MMC_L.sp-24														
> 15 cm (5.9in) diameter														
Species	**30% t.l. Down wood cover (%)**	**50% t.l. Down wood cover (%)**	**80% t.l. Down wood cover (%)**											
Three-toed woodpecker	6.5	17	32											
Downwood														
Tolerance Interval (t.i.)														
Table EMC_S/L.sp-24, LP_S/L.sp24, MMC_S.sp-24 and MMC_L.sp-24														
Down Wood Size ≥12cm (5") dbh														
t.i.	**Down wood cover (%)**	Query												
0	0	=0												
0-30%	0-6.5	>0 and <=6.5												
30-50%	6.5-17	>6.5 and <=17												
50-80%	17-32	>17 and												

		<=32												
80% +	32+	>32												
*Down wood cover categories are 12, 25, 50, 75 and 100% this may over estimate as the study from which tolerance levels were developed only measured downwood greater than 15cm.														
Pileated Woodpecker														
Distribution of snags by Tolerance intervals for Pileated woodpecker for Forest														
	% of Nesting Habitat for Snags ≥ 10" dbh						**% of Nesting Habitat for Snags ≥ 20" dbh**							
Tolerance Interval	**0**	**0-30%**	**30-50%**	**50-80%**	**80%+**		**0**	**0-30%**	**30-50%**	**50-80%**	**80%+**			
Snags/Acre	**0**	**0-14.9**	**14.9-30.1**	**30.1-49.3**	**49.3+**		**0**	**0-3.5**	**3.5-7.8**	**7.8-18.4**	**18.4+**			
Forest Total	3%	48%	37%	7%	4%		16%	36%	30%	16%	2%			
Distribution of snags by Tolerance intervals for Pileated woodpecker for Snags ≥ 20" dbh by Subwatershed														
			Nesting Acres						**% of Nesting Habitat**					
% of Nesting Habitat	**6th Field subwatershed**	**Tolerance Interval**	**0**	**0-30%**	**30-50%**	**50-80%**	**80%+**	**Total Acres**	**0**	**0-30%**	**30-50%**	**50-80%**	**80%+**	
		Snags/Acre	**0**	**0-3.5**	**3.5-7.8**	**7.8-18.4**	**18.4+**		**0**	**0-3.5**	**3.5-7.8**	**7.8-18.4**	**18.4+**	**Total**
1%	Bull Creek		308	508	435	82		1,333	23%	38%	33%	6%	0%	100%
Distribution of snags by Tolerance intervals for Pileated woodpecker for Snags ≥ 10" dbh by Subwatershed														
			Nesting Acres						**% of Nesting Habitat**					
% of Nesting Habitat	**6th Field subwatershed**	**Tolerance Interval**	**0**	**0-30%**	**30-50%**	**50-80%**	**80%+**	**Total Acres**	**0**	**0-30%**	**30-50%**	**50-80%**	**80%+**	
		Snags/Acre	**0**	**0-14.9**	**14.9-30.1**	**30.1-49.3**	**49.3+**		**0**	**0-14.9**	**14.9-30.1**	**30.1-49.3**	**49.3+**	**Total**
0.7%	Bull Creek		14	499	667	90	64	1,333	1%	37%	50%	7%	5%	100%
Down Wood for Pileated Woodpecker														
Table EMC_S/L.sp-24.														
≥15cm dbh														
Species	**30% t.l. Down wood cover (%)**	**50% t.l. Down wood cover (%)**	**80% t.l. Down wood cover (%)**											
Pileated Woodpecker	4	4.5	5.1											
Presence	Down Wood Tolerance Intervals (t.i.)													
	Based on DecAID table EMC_S/L.sp-24													
	Down Wood Size ≥12cm (5") dbh													

	t.i.	Down wood % cover	Query on DCOV_GE_12*
	0	0	=0
	0-30%	0-4	>0 and <=4
	30-50%	4-4.5	>4 and <=4.5
	50-80%	4.5-5.1	>4.5 and <=5.1
	80%+	5.1+	>5.1
	*Down wood cover categories are 12, 25, 50, 75 and 100% this may over estimate as the study from which tolerance levels were developed only measured downwood greater than 15cm.		

Distribution of Down Wood by Tolerance Intervals for Pileated Woodpecker for Downwood≥ 5" dbh by Subwatershed

			Nesting Acres						% of Nesting Habitat					
% of Nesting Habitat	**6th Field subwatershed**	**Tolerance Interval**	**0**	**0-30%**	**30-50%**	**50-80%**	**80%+**	**Total Acres**	**0**	**0-30%**	**30-50%**	**50-80%**	**80%+**	
		% Down Wood Cover	**0**	**0-4**	**4-4.5**	**4.5-5.1**	**5.1+**		**0**	**0-4**	**4-4.5**	**4.5-5.1**	**5.1+**	**Total**
0.7%	Bull Creek		18	616	45	0	653	1,333	1%	46%	3%	0%	49%	100%

Hairy Woodpecker

Distribution of snags by Tolerance intervals for Hairy woodpecker for Snags ≥ 10" dbh

	Nesting Acres by Subwatershed							**% of Nesting Habitat**						
% of Habitat		**Hairy woodpecker ONLY - NOT Tolerance Levels**	**no nesting habitat**	**providing minimal nesting**	**providing nesting habitat**	**providing optimal nesting habitat**	**Total Acres**	**no nesting habitat**	**providing minimal nesting**	**providing nesting habitat**	**providing optimal nesting habitat**			
	6th Field subwatershed	**Snags/Acre**	**0**	**0-0.1**	**0.1-3.7**	**>3.7**		**0**	**0-0.1**	**0.1-3.7**	**>3.7**	**Total**		
0%	Bull Creek		1,627		110	598	2,335	70%	0%	5%	26%	100%		

Black-backed woodpecker

Distribution of snags by Tolerance intervals for Black-back woodpecker for Snags ≥ 10" dbh by Subwatershed

		Nesting Acres						**% of Nesting Habitat**					
% of Nesting Habitat		**Tolerance Interval**	**0**	**0-30%**	**30-50%**	**50-80%**	**80%+**	**Total Acres**	**0**	**0-30%**	**30-50%**	**50-80%**	**80%+**	

	6th Field subwatershed	Snags/Acre	0	0-2.5	2.5-13.6	13.6-29.2	29.2+		0	0-2.5	2.5-13.6	13.6-29.2	29.2+	Total
0%	Bull Creek		433	30	356	78	112	1,010	43%	3%	35%	8%	11%	100%

Down Wood for Black-backed woodpecker			
Tolerance Levels (t.l.)			
Table EMC_S/L.sp-24,Table LP_S/L.sp-24			
> 15 cm (6in) diameter			
Species	**30% t.l. Down wood cover (%)**	**50% t.l. Down wood cover (%)**	**80% t.l. Down wood cover (%)**
Black-backed woodpecker	4.7	13	25.1
Tables EMC_S.sp-24, EMC_L.sp-24, and LP_S/L.sp-24			
>=14 or >=22 cm diameter, (5.5 in or 8.5 in)			
Species	**30% t.l. Down wood cover (%)**	**50% t.l. Dow wood cover (%)**	**80% t.l. Down wood cover (%)**
Black-backed woodpecker	4.7	13	25.1

Query completed		DW Tolerance Intervals (t.i.)
Down Wood Size ≥12cm (5") dbh		
t.i.	**Down wood cover (%)**	**Query**
0	0	=0
0-30%	0-4.7	>0 and <=4.7

30-50%	4.7-13	>4.7 and <=13												
50-80%	13-25.1	>13 and <=25.1												
80% +	25.1+	>25.1												
Based on DecAID table EMC_S.sp-24, EMC_L.sp-24and LP_S/L.sp-24 *Down wood cover categories are 12, 25, 50, 75 and 100% this may over estimate as the study from which tolerance levels were developed only measured downwood greater than 14cm.														
Distribution of Down Wood by Tolerance Intervals for Black-back Woodpecker for Downwood≥ 5" dbh by Subwatershed														
			Nesting Acres						**% of Nesting Habitat**					
% of Nesting Habitat		**Tolerance Interval**	**0**	**0-30%**	**30-50%**	**50-80%**	**80%+**	**Total Acres**	**0**	**0-30%**	**30-50%**	**50-80%**	**80% +**	
	6th Field subwatershed	**% Down Wood Cover**	**0**	**0-4.7**	**4.7-13**	**13.25.1**	**25.1+**		**0**	**0-4.7**	**4.7-13**	**13.25.1**	**25.1 +**	**Total**
0%	Bull Creek		433	30	356	78	112	1,010	43%	3%	35%	8%	11%	100%

Table 21: Northwest Forest Plan Species of Concern - Bats

NORTHWEST FOREST PLAN SPECIES OF CONCERN: BATS				
Species	**Status**	**Nature Serve Ranking**	**Habitat**	**Habitat/Presence in Allotment**
Townsend's big-eared bat (*Corynorhinus townsendii*)	Sensitive	S2	Ponderosa pine, caves, bridges, buildings	Potential foraging habitat
Pallid bat (*Antrozous pallidus*)	Sensitive	S2	Arid canyons, sagebrush, caves, buildings	No habitat
Spotted bat (*Euderma maculatum*)	Sensitive	S2	Cliffs, arid canyons, sagebrush, caves	No habitat
Fringed myotis (*Myotis thysanodes*)	Sensitive	S2	Mixed forests, arid habitat, bridges, caves, buildings	Potential habitat
California myotis (*Myotis californicus*)			Mixed forests, caves, bridges, buildings	Potential habitat
Yuma myotis (*Myotis yumanensis*)		S3	Mixed forests, caves, bridges, buildings	Potential habitat
Little brown myotis (*Myotis lucifugus*)		S4	Mixed forests, caves, bridges, buildings	Potential habitat
Long-legged myotis (*Myotis volans*)		S3	Ponderosa pine forests, caves, bridges	Potential habitat
Long-eared myotis (*Myotis evotis*)		S4	Mixed forests, bridges, caves, buildings	Potential habitat
Silver-haired bat (*Lasionycteris noctivagans*)		S3, S4	Mixed forests	Potential habitat
Hoary bat (*Lasiurus cinereus*)		S3	Mixed forests	Potential habitat
Big brown bat (*Eptesicus fuscus*)		S4	Mixed forests, bridges, caves, buildings	Potential habitat
Western small-footed bat (*Myotis ciliolabrum*)		S3, S4	Mixed forests, arid habitat, bridges, caves, buildings	Potential habitat
Canyon bat (*Parastrellus hesperus*)		S4	Arid canyons, sagebrush, caves	Potential habitat

Table 22: Landbird Focal Species and Priority Habitat Features

Habitat	Habitat Feature /Conservation Focus	Focal Species	Habitat/Presence in watershed
PONDEROSA PINE	Large patches of old forest with large snags	White-headed woodpecker	Potential habitat; presence unknown
	Large trees	Pygmy nuthatch	Potential habitat; presence unknown
	Open understory with regenerating pines	Chipping sparrow	Potential habitat; presence unknown
	Patches of burned old forest	Lewis' woodpecker	Potential habitat; presence unknown
Mixed Conifer (Late Successional)	Large trees	Brown creeper	Potential habitat; presence unknown
	Large snags	Williamson's sapsucker	Potential habitat; presence unknown
	Interspersion grassy openings and dense thickets	Flammulated owl	Potential habitat; presence unknown
	Multi-layered dense canopy	Hermit thrush	Potential habitat; presence unknown
	Edges and opening created by wildfire	Olive-sided flycatcher	Potential habitat; presence unknown
UNIQUE HABITATS			
Lodgepole pine	Old growth	Black-backed woodpecker	Potential habitat; presence unknown
Whitebark pine	Old growth	Clark's nutcracker	Potential habitat; presence unknown
Meadows	Wet/dry	Sandhill crane	No habitat
Aspen	Large trees with regeneration	Red-naped sapsucker	No habitat
Subalpine fir	Patchy presence	Blue grouse	Potential habitat

Table 23: Birds of Conservation Concern and High Priority Shorebirds, Status, Habitat, and Presence in Bull Creek Watershed

Species	Status**	Habitat	Habitat/Presence in Watershed
Greater sage grouse	Sensitive, BCC	Sagebrush steppe	No habitat in watershed.
Eared grebe	BCC	Lakes, ponds	No habitat on Forest land. Documented occurrence at Tumalo Reservoir in the watershed on private land east of Forest boundary.
Bald eagle	Sensitive, MIS, BCC	Lakeside or riverside with large trees	No habitat
Ferruginous hawk	Landbird Focal, BCC	Open country in sagebrush flats.	No habitat
Golden eagle	MIS, BCC	Open country in sagebrush flats.	No habitat on Forest land. Potential habitat in watershed east of Forest boundary.
American Peregrine Falcon	MIS, BCC	Riparian, cliffs	Potential foraging habitat on Forest land. Documented occurrence at Tumalo Reservoir in the watershed on private land east of Forest boundary.
Yellow Rail	Sensitive, BCC	Marsh	No habitat on Forest lands in the watershed. Potential habitat at Tumalo Reservoir in the watershed on private lands east of the Forest boundary.
Flammulated owl	BCC	Prefers mature growth in ponderosa pine with open canopy; avoids dense young stands	Potential habitat on Forest lands in watershed.
Yellow-billed cuckoo	Landbird Focal, BCC	Large expanses of riparian forests.	No known breeding populations in Oregon. Rare, irregular visitor east of the Cascades, mostly in eastern Oregon. One female with a brood patch found dead in Bend, Oregon, near the Deschutes River in 1981.
Tricolored blackbird	Sensitive, BCC	Hardstem bulrush, cattail, nettles, dense willows and blackberries in emergent marshes.	Uncommon to rare in fall and winter in Crook and Deschutes County.
Calliope Hummingbird	BCC	Open montane forest, mountain meadows, and willow and alder thickets, gardens; in migration and winter also in chaparral, lowland brushy areas, deserts	Potential habitat
Black swift	BCC	Breeds on steep cliffs, behind waterfalls, and on coastal rocky shorelines.	Closest documented occurrence is Crooked River Canyon in Deschutes County.
White-headed woodpecker	Sensitive, MIS, BCC	Mature ponderosa pine forests; weak excavator	Potential habitat in watershed.
Lewis' woodpecker	Sensitive, MIS, BCC	Mature ponderosa pine forests; weak excavator	Potential habitat in watershed.
Williamson's woodpecker	MIS, BCC	Mature mixed conifer forests.	Potential habitat in watershed.
Willow flycatcher	BCC	Riparian habitat.	Potential habitat in watershed.
Loggerhead shrike	Landbird Focal, BCC	In Oregon nests in sagebrush steppe seasonally wet playa.	In Deschutes County, uncommon to locally common summer resident, uncommon spring and fall migrant, and rare winter visitor.
Pinyon jay	BCC	Juniper and sagebrush.	Potential habitat in watershed.
Virginia's warbler	Landbird Focal, BCC	Mountain mahogany groves.	Breeding has not been confirmed in eastern Oregon but may occur in Malheur and Lake counties.

Species	Status**	Habitat	Habitat/Presence in Watershed
Sage thrasher	BCC	Juniper and sagebrush.	Potential habitat in watershed.
Green-tailed towhee	BCC	Mountain slopes, plateaus, and higher valleys in arid habitat; associated with dense shrubs 0.5 to 1.5 m in height; Most commonly uses dry shrubby hillsides and post-disturbance shrubby second growth.	Potential habitat in watershed.
Black rosy-finch	BCC	Nests in barren, rocky or grassy areas and cliffs among glaciers or beyond timberline; in migration and winter occurs in open fields, cultivated lands, brushy areas, and around human habitation.	Potential habitat in watershed.
Black-chinned sparrow	BCC	Chaparral, sagebrush, and arid scrub; on gentle hillsides to steep, rocky slopes, or in brushy canyons	Potential habitat in watershed.
Brewer's sparrow	Landbird Focal, BCC	Nests in sagebrush steppe and big sagebrush shrubland.	Common spring and fall migrant and common to locally abundant summer resident at lower elevation sagebrush habitats. Breeding records in central Jefferson, eastern Deschutes and southeast Crook counties.
Sage sparrow	Landbird Focal, BCC	Sagebrush and chaparral with scattered bushes.	Uncommon spring and fall migrant and locally common summer resident. Breeding confirmed east of Horse Ridge in Deschutes County and in southern Crook County, with isolated breeding populations in north central Deschutes and south central Jefferson counties.
Piping plover	HI	Inhabit sandy beaches with sparse vegetation.	Breeds around the Great Lakes and along the north Atlantic coast; winters along south Atlantic coast and the Carribbean. One individual observed on the Oregon coast in Tillamook County in 1986.
Snowy plover	BCC, HI	Nests on open sandy areas on beaches and inland on sparsely vegetated alkaline playas.	Breeds on the Oregon coast and in Harney and Lake counties in eastern Oregon. Intermittently reported from Klamath County.
Mountain plover	HI	Breeds on dry, open flat tablelands, intensively grazed areas, and on black-tailed prairie dog towns.	Breeds on high plateaus in the Rockies and winters in Texas, central and southern California and Mexico. Eight records for Oregon on coast and in Corvallis. No habitat on Forest lands or non-Forest lands in the watershed.
Wilson's plover	HC	Breeds along Pacific and Atlantic coasts on open sand, shell beaches or tidal mudflats.	Only Oregon record in 1998 in Coos County on the Oregon coast. No habitat on Forest lands in the watershed. Potential habitat at Tumalo Reservoir on private land in watershed east of Forest boundary.
Whimbrel	HC	Inland grassy marshes and mudflats or fields around lakes or ponds; tidal flats and sandy ocean beaches on the coast.	Documented in eastern Deschutes County. No habitat on Forest lands in the watershed. Potential habitat at Tumalo Reservoir on private land in watershed east of Forest boundary.
Sanderling	HC	Breeds in dry tundra in northern Alaska. Outside the breeding season, inland migrants inhabit sandbars along rivers and on lake beaches.	Rare fall migrant on the Forest; observed at Wickiup Reservoir. No habitat on Forest lands in the watershed. Potential habitat at Tumalo Reservoir on private land in watershed east of Forest boundary.

Species	Status**	Habitat	Habitat/Presence in Watershed
Upland sandpiper	HC	Inhabits prairie-grassland habitat and montane meadows surrounded by lodgepole and sometimes ponderosa pine.	Very rare breeder in Oregon and remainder of the Northwest. Closest breeding records are Sycan Marsh in Lake County. Not recorded on the Forest. No habitat on Forest lands in the watershed. Potential habitat at Tumalo Reservoir on private land in watershed east of Forest boundary.
Buff-breasted sandpiper	HI	Nests in dry tundra in northern Alaska and northern Canada.	Rare but regular migrant along the Oregon coast and casual inland. Fall records documented near Prineville in Crook County and at the Redmond sewage ponds. No habitat on Forest lands in the watershed. Potential habitat at Tumalo Reservoir on private land in watershed east of Forest boundary.
Western sandpiper	HC	Nests in mosaic of wet low-lying grass and sedge marshes dotted with small pools and lakes, and relatively well-drained heath-covered tundra such as hummocks.	Common spring and fall migrant along ponds and lakeshores, especially Hatfield Lake and larger irrigation reservoirs. Low potential as spring or fall migrant in project area. No habitat on Forest lands in the watershed. Documented occurrence at Tumalo Reservoir on private land in watershed east of Forest boundary.
Black oystercatcher	HC	Rocky shores and sand/gravel beaches along Oregon coast.	Resident from w. Aleutians south along the Pacific coast to central Baja California.
American oystercatcher	HC	Rocky shores and sand/gravel beaches along Oregon coast.	Resident from w. Aleutians south along the Pacific coast to central Baja California.
Long-billed curlew	BCC, HI	Breeding habitat includes grasslands ranging from moist meadowland to very dry prairie. Strongest Oregon breeding habitat association in low-dwarf sagebrush. Non-breeding habitat includes shallow margins of inland and coastal waters, open areas of marshes, intertidal zones, or sandbars.	Uncommon to rare summer resident. Most often found in low sagebrush flats and cultivated fields. Spring migrants have been observed in Camp Polk Meadow in Northern Deschutes County, with confirmed nesting at Big Summit Prairie in Northern Jefferson County.
Bristle-thighed curlew	HC	Inland, inhabits short-grass and mixed-grass habitats for breeding and wintering. During migration, readily uses agricultural areas.	Locally common breeder in open grasslands in Klamath, Lake, Harney, Crook, Umatilla, Morrow, Union, Malheur, and Baker counties. No habitat on Forest lands in the watershed. Potential habitat at Tumalo Reservoir on private land in watershed east of Forest boundary.
Hudsonian godwit	HC	Nests on mixed tundra/grasslands. Habitat includes muddy, sandy or rocky shores, freshwater marshes, mudflats and flooded fields,	Breeds in north-central Canada through extreme northeastern Alaska and winters mostly in South America. There are 12 records for Oregon including 1 spring record in Klamath County. No habitat on Forest lands in the watershed. Potential habitat at Tumalo Reservoir on private land in watershed east of Forest boundary.
Bar-tailed godwit	HC	Breeds on lowland tundra but sometimes in upland treed areas. Migration and winters on coasts.	None documented east of the Cascades. No habitat on Forest lands in the watershed. Potential habitat at Tumalo Reservoir on private land in watershed east of Forest boundary.
Marbled godwit	BCC	Expansive mudflats and sandflats on beaches; migration	Irregular migrant in eastern Oregon and casual winter visitor in eastern Oregon. No habitat on

Species	Status**	Habitat	Habitat/Presence in Watershed
		and winter habitat on wet margins of large reservoirs or brackish lakes, sewage ponds, and golf courses.	Forest lands in the watershed. Potential habitat at Tumalo Reservoir on private land in watershed east of Forest boundary.
Black turnstone	HC	Inhabits rocky shores, jetties, mudflats, sandy beaches, and pasturelands.	Common transient and winter visitor to the coast. Scattered inland records including a 1985 record of two individuals at the Ochoco Reservoir in Crook County. No habitat on Forest lands in the watershed. Potential habitat at Tumalo Reservoir on private land in watershed east of Forest boundary.
Surfbird	HC	Inhabits rocky intertidal zone, occasionally mudflats and sandy beaches.	Strictly coastal in Oregon with no inland records. No habitat on Forest lands in the watershed.
Western sandpiper	HC	In the Cascades, migrants are occasionally observed along shorelines of reservoirs, lakes, ponds and wet meadows.	Common migrant along lake shorelines. No habitat on Forest lands in the watershed. Documented at Tumalo Reservoir on private land in watershed east of Forest boundary.
Rock sandpiper	HC	Breeds in Alaska and Northwest coast on jetties, rocky estuaries, and tide pools, rarely on estuarine mudflats.	Strictly coastal with no inland records in Oregon. Not documented in the Bull Creek watershed.
Short-billed dowitcher	HC	Breeds across subarctic Canada and southern Alaska in tidal mudflats and flooded pastures.	Common to locally abundant coastal migrant; regular migrant east of the Cascades.
Ruddy turnstone	HC	Rocky shores, ocean beaches, mudflats, and flooded fields.	Numerous fall records east of the Cascades.
Red knot	HI	Breeds in tundra of Canada and Alaska. Winters on open estuarine tide flats on the coast and large brackish lakes; rarely found on margins or large freshwater lakes or reservoirs.	Casual spring and fall migrant in the Willamette Valley, occasionally in the Rogue Valley; rare transient in eastern Oregon. Not documented in the Bull Creek watershed.
Dunlin	HC	Breeds in southwest Alaska north and east to eastern Canada; winters along coast from British Columbia to Mexico.	Rare migrant in the Cascades along shorelines of reservoirs, lakes, ponds, wet meadows during migration. Migrants documented at Wickiup Reservoir. Generally does not winter east of the Cascades. Not documented in the Bull Creek watershed.

* Sensitive = U.S. Forest Service Regional Forester List December 9, 2011
MIS = Management Indicator Species, Deschutes National Forest LRMP 1990
Focal = Landbird Focal Species, Conservation Strategy for Landbirds of the East-Slope of the Cascade Mountains in Oregon and Washington (Altman 2000)
BCC = Birds of Conservation Concern (USDI FWS 2008)
HI = Highly Imperiled, HC = High Concern (High Priority Shorebirds, USDI FWS 2004)

APPENDIX B – BOTANY

DESCHUTES NATIONAL FOREST SENSITIVE PLANT SPECIES LIST

(*List updated January 2008*).

D = Documented on the Forest; S = Suspected on the Forest

Scientific Name and Code	Common Name	DES	Habitat
Vascular Plants			
Agoseris elata	tall agoseris	D	Forest openings and forest edges adjacent to wet/moist meadows, lakes, rivers, streams. Ponderosa pine/ bitterbrush/Idaho fescue plant association; also with lodgepole pine, mixed conifer, and Englemann spruce.
Arabis suffrutescens var. horizontalis	horizontal woody rockcress	S	Meadows, woods; summits, ridges; steep, exposed rock outcrops. TNC records (as recent as 1993) only from Crater Lake NP, Lake of the Woods, and Mt. McLoughlin.
Arnica viscosa	Mt. Shasta arnica	D	Sparsely vegetated openings at high elevations. Scree, talus gullies and slopes w/ seasonal water runoff. Lava flows. May be w/in moraine lake basins or crater lake basins.
Astragalus peckii	Peck's milk-vetch	D	Basins, benches, gentle slopes, pumice flats. Generally a non-forest species but can occur in lodgepole pine openings. Mostly in sagebrush/grassland habitats.
Botrychium pumicola	pumice grape-fern	D	Alpine and subalpine ridges, slopes and meadows. Montane LP forest openings, open forest in basins containing frost pockets or pumice flats.
Calamagrostis breweri	Brewer's reedgrass	S	Alpine to subalpine habitats in meadows, open slopes, streambanks, and lake margins.
Carex abrupta	abrupt-beaked sedge	D	Ponderosa forests, alpine fell fields, meadows, roadsides, and open slopes, usually in dry soil. From 1,400m to high elevations.
Carex capitata	capitate sedge	D	Usually in open, wet places, but sometimes in drier sites at high elevations. Known from five sites on the Sisters, Bend, and Crescent districts of the Deschutes National Forest.
Carex diandra	lesser panicled sedge	S	Lesser panicled sedge. Swamps, sphagnum bogs, lake margins, and wet, often calcareous meadows at moderate elevations.
Carex lasiocarpa var. americana	slender sedge	D	Swamps and wet meadows at mid elevations. Found along the Deschutes River, south of Bend.
Carex livida	livid sedge	S	Occurs in all forest types in peatlands including fens and bogs; wet meadows with still or channelled water.
Carex retrorsa	retrorse sedge	S	Wet meadows, bogs, swamps, and edges of streams, lakes, and rivers. Foothills and lowlands. ORNHIC data elevations range from 10' – 3,000'.
Carex vernacula	native sedge	S	Moist or wet places at high elevations, especially at the edges of melting snowfields and in meltwater streams. ORNHIC data elevations range from 7760' – 9110'.
Castilleja chlorotica	green-tinged paintbrush	D	Ponderosa pine, lodgepole pine, and mixed conifer forest openings.
Cheilanthes feei	Fee's lip-fern	S	Located in crevices on cliffs. Known from NE Oregon.
Collomia mazama	Mt. Mazama collomia	S	Meadows (dry to wet, level to sloping); stream banks and bars; lakeshores and vernal pool margins; forest edges and openings; alpine slopes.
Cyperus acuminatus	short-pointed cyperus	D	On the Deschutes NF, located on damp mineral soil of a broad, low-gradient shore of reservoir, in a community just below the *Spiraea* community.
Cyperus lupulinus ssp. lupulinus	A cyperus	S	Upper shorelines. Known from NE Oregon.
Elatine brachysperma	short-seeded waterwort	S	In California, 164 - 1640 ft elev. Hitch. and Cron. says Cent. OR. Known sites in Grant, Lake, Malheur, Union, Wallowa Counties. In addition, Lucile Housley (BLM) reported (2004) Harney, Malheur Cos. One site says heavy horse, cattle use.

Scientific Name and Code	Common Name	DES	Habitat
*Eucephalus gormanii (*formerly *Aster gormanii)*	Gorman's aster	S	Alpine or subalpine mixed conifer, open to partially closed canopy. Rocky ridges, outcrops, or rocky slopes.
Gentiana newberryi var. newberryi	alpine gentian	D	Alpine-subalpine mixed conifer openings. *Deschampsia cespitosa* meadows. Montane wet to dry meadows, sometimes adjacent to springs, streams, or lakes.
Heliotropium curassavicum	salt heliotrope	S	Alkaline w/ greasewood. Harney, Malheur, Union, Baker, Lake Cos.
Lipocarpha aristulata	aristulate lipocarpha	S	Documented in Washington with *Rorippa columbiae* and *Rotala ramosior.* Wallowa and Malheur Cos.
Lobelia dortmanna	Dortmann's cardinalflower	D	In water of lake, pond, slow river or stream, or wet meadow. Only one known location in Oregon on Deschutes National Forest.
Lycopodiella inundata	inundated clubmoss	D	Deflation areas in coastal back-dunes; montane bogs, including Sphagnum bogs; less often, wet meadows.
Lycopodium complanatum	ground cedar	S	Edges of wet meadows; dry, forested midslope with 25% canopy cover.
Muhlenbergia minutissima	annual dropseed	S	Weathered lava soils in riparian; only ORNHIC site in Oregon is Jordan Crater, Malheur Co.
Ophioglossum pusillum	northern adderstongue	S	Dune deflation plains; marsh edges; vernal ponds and stream terraces in moist meadows.
Penstemon peckii	Peck's penstemon	D	Ponderosa pine forest openings, pine/mixed conifer openings; recovering fluvial surfaces (streambanks, overflow channels, inactive floodplains); seeps, rills, springs, vernal pools; draws, ditches, skid roads; dry or intermittant stream channels; moist-wet meadows.
Pilularia americana	American pillwort	S	Alkali and other shallow vernal pools; not recently used stock ponds; reservoir shores.
Potamogeton diversifolius	Rafinesque's pondweed	S	Lakes, ponds, including created habitat. Klamath, Harney and Lake Cos.
Rorippa columbiae	Columbia yellowcress	D	Wet to vernally moist sites; meadows, fields, playas, lakeshores, intermittent stream beds, banks of perennial streams, along irrigation ditches, river bars and deltas.
Rotala ramosior	lowland toothcup	S	In Oregon, low elevation (<2300 ft) below high water, including created habitat in wet, swampy places, lakes and pond margins, and free-flowing river reaches. Benton, Columbia, Marion, Hood River., Harney, Multnomah and Linn Cos.
Scheuchzeria palustris ssp. americana	rannoch-rush	D	Open canopied bogs, fens, and other wetlands where often in shallow water.
*Schoenoplectus subterminalis (*formerly *Scirpus subterminalis)*	swaying bulrush	D	Generally submerged to emergent in quiet water 2-8 decimeters deep, in peatlands, sedge fens, creeks, ditches, ponds and lakes.
Utricularia minor	lesser bladderwort	D	Occurs underwater in lowland and montane fens, sedge meadows, low-nutrient lakes and peatbog pools. Deschutes, Clackamas, Lane, Klamath, Jackson, Coos, Douglas, Harney, Marion and Linn Cos. There are documented populations on the Bend and Sisters districts of the Deschutes National Forest.
Bryophytes			
Barbilophozia lycopodioides	liverwort	S	Forming mats on peaty soil on damp ledges of rock outcrops and cliffs at higher elevations. Sites receive abundant snowfall. Elevations of known sites in Oregon and Washington range from 3400 to 7500 feet. Forest types include *Abies amabilis, Abies lasiocarpa, Abies procera, Abies lasiocarpa, Picea engelmannii, Pinus contorta* ssp. *latifolia,* and *Tsuga mertensiana* associations.

Scientific Name and Code	Common Name	DES	Habitat
Brachydontium olympicum	moss	S	Forming loose mats on exposed acidic boulders or soil in rock crevices. In boulder fields, moraines, and ledges of cliffs, often in areas of late snowmelt. Subalpine to alpine elevations between 5,000 and 6,000 feet. On Oregon's Mt. Hood *Brachydontium* occurs above timberline at about 6,000 ft where the plant association is probably *Phyllodoce empetriformis* and *Cassiope mertensiana* heath. Elsewhere in the Pacific Northwest, *Brachydontium* probably also occurs in *Pinus albicaulis, Tsuga mertensiana, Abies lasiocarpa,* and *Abies amabilis* associations.
Chiloscyphus gemmiparus	liverwort	S	Forming small turfs or clumps on rocks in beds of cold montane streams, submerged or emergent in the splash zone, full shade to partial sun. Some streams drain lakes with motorized boating access. Elevations in Oregon range from 5000-7000 feet. Known sites in the Pacific Northwest include *Abies amabilis, Abies lasiocarpa,* and *Tsuga mertensiana* associations.
Conostomum tetragonum	moss	S	Occurring as small sods or inconspicuous individual shoots intermixed with other bryophytes, on soil in rock crevices in boulder fields, moraines, and ledges of cliffs. Subalpine to alpine elevations, often in areas of late snowmelt. On Oregon's Mt. Hood, *Conostomum* occurs above timberline at about 6,500 ft, where the plant association is probably *Phyllodoce empetriformis* and *Cassiope mertensiana* heath. Elsewhere in the Pacific Northwest, *Conostomum* probably also occurs in *Pinus albicaulis, Tsuga mertensiana, Abies lasiocarpa*, and *Abies amabilis* associations.
Helodium blandowii	moss	D	Forming mats and small hummocks in medium to rich montane fens with calcareous groundwater. S ometimes under sedges and shrubs around the edges of fens or along streamlets in fens. Elevations range from 5000-6000 feet. Forest types include *Abies amabilis*, *Abies concolor, Abies* x *shastensis*, and *Pinus contorta* ssp. *latifolia* associations.
Polytrichium sphaerothecium	moss	S	Forming green to brown sods on igneous rocks in exposed or sheltered sites, subalpine parkland to alpine krummholz. On Oregon's Mt. Hood, *Polytrichastrum sexangulare* var. *vulcanicum* occurs at or above timberline at about 6,500 ft elevation, where the plant association is probably *Phyllodoce empetriformis* or *Cassiope mertensiana* heath. Elsewhere in the Pacific Northwest it probably also occurs in *Pinus albicaulis, Tsuga mertensiana, Abies lasiocarpa*, and possibly *Abies amabilis* associations.
Pseudocalliergon trifarium	moss	S	Forming lawns or inconspicuously intermixed with other bryophytes in medium to rich montane fens where it grows submerged to emergent in pools or on saturated ground, usually in full sunlight. Fen pools may dry up in late summer. Elevations range from 5000-6000 feet. Forest types include *Abies amabilis, Abies concolor, Abies x shastensis, and Pinus contorta ssp. latifolia* associations.
Rhizomnium nudum	rhizomnium moss	D	On humus or mineral soil in seepages, vernally (at least) wet depressions or intermittently wet, low gradient channels. Exposure varies from full sun to full shade. Coniferous forests, that include silver fir, western hemlock, mountain hemlock, western red cedar and Engelman spruce, and on Deschutes NF include lodgepole pine, Engelman spruce, mountain hemlock and western white pine.
Schistostega pennata	luminous moss	D	Usually on mineral soil in crevices on lower and more sheltered parts of root wads of fallen trees. A rare occurrence in a natural cave in upper bank of perennial creek. Often near steams or other wet areas. Canopy often full but as low as 20% at humid sites near water. Most commonly found within silver fir plant series but also common in western hemlock and mountain hemlock series. Also in lodgepole pine stands near water. Stands are typically late seral or old growth.

Scientific Name and Code	Common Name	DES	Habitat
Splachnum ampullaceum	moss	S	Forming green sods on old dung of herbivores, or on soil enriched by dung, in peatlands or other wetlands. In Oregon, occurs between 5,000-5,500 feet elevation, but Hutten et al. (2005) reported it from as low as 500 feet in Olympic National Park.
Tomentypnum nitens	moss	D	Forming loose or dense sods or intermixed with other bryophytes in medium to rich montane fens where it favors slightly elevated sites such as logs, stumps, or hummocks formed by *Vacccinium uliginosum* and *Betula glandulosa.* Elevations range from 5000 to 6000 feet. Fens occur in openings in forest types that include *Abies amabilis, Abies concolor, Abies lasiocarpa,* and *Pinus contorta* ssp. *latifolia* associations. Many sites on all three districts of the Deschutes National Forest.
Trematodon boasii	moss	S	Forming loose mats on moist bare soil along the edges of trails, streams and ponds in the subalpine zone. Soils usually have some organic content and are irrigated by meltwater from late-season snowbeds. Little is known about associated species. Habitats probably include *Phyllodoce empetriformis* and *Cassiope mertensiana heath* and *Tsuga mertensiana, Abies lasiocarpa,* and *Abies amabilis* forest associations.
Tritomaria exsectiformis	liverwort	D	Within the Pacific Northwest, currently known from mid-elevational (3200-5200 feet) riparian zones ans spring-fed hydrologic systems. Typically open to shaded coniferous forest in association with low volume, perennial water flow at or near springs and seeps, along very gentle topographic gradients. Lodgepole pine (*Pinus contorta*) is present at nearly all sites within the Oregon and Washington Cascades. Other tree species include white fir, ponderosa pine, Engelmann spruce (*Picea engelmannii*), Douglas fir (*Pseudotsuga menziesii*), western hemlock (*Tusga heterophylla*), mountain hemlock (*Tusga mertensiana*), and subalpine fir (*Abies lasiocarpa*).
Lichens			
Dermatocarpon. luridum	silverskin lichen	D	Rocks or bedrock in streams or seeps, usually submerged or inundated for most of the year.
Leptogium cyanescens	skin lichen	S	Generally riparian but recently documented in upland settings on vine maple, big leaf maple and intermixed with moss on white oak.
Texosporium sancti-jacobi	lichen	S	Whitish soil crust lichen often found on old root clumps of *P. secunda* or scat. Documented on The Island and Canadian Bench, CRNG. Undocumented occurrences by R. Demmer on BLM along breaks of lower John Day R.
Fungi			
Alpova alexsmithii	fungus	D	Occurs principally on soil in Pacific Silver Fir (44%) and Mountain Hemlock (44%) series at elevations of 2742-5764 feet. A mycorrhizal associate of *Tsuga*. Associated species include Pacific silver fir, lodgepole pine, Engelmann spruce and mountain hemlock. Other woody associates include *Vaccinium membranaceum* and *Vaccinium scoparium*. Fruits August-December. Documented from the Mt. Jefferson Wilderness on the Deschutes National Forest.
Gastroboletus vividus	fungus	S	Found in association with the roots of *Abies magnifica* and *Tsuga mertensiana* above 5,000'. Fruits July-September. A known site at Crater Lake National Park.
Helvella crassitunicata	fungus	D	Occurs in montane forests containing *Abies* spp., from old growth and younger age groups, from low to high elevation in the fall and winter, occasionally on trails, or other moderately disturbed areas. Documented on the Sisters district of the Deschutes National Forest.
Hygrophorus caeruleus	fungus	D	Associated with roots of Pinaceae; may be restricted to *Abies*. Typically fruits in mid-elevation to montane conifer forests in the spring near melting snowbanks. Fruits May-July. Documented on the Deschutes National Forest.

Scientific Name and Code	Common Name	DES	Habitat
Leucogaster citrinus	Fungus	D	The one known site on Bend/Ft. Rock District occurs along a hiking trail in a lodgepole pine forest with *Tsuga mertensiana* and *Vaccinium scoparium,* where it occurs on bare soil in partial shade.
Ramaria amyloidea	fungus	D	Humus or soil. Fruits in September and October. Found in Douglas fir, grand/white fir, and hemlock forests.

DESCHUTES NATIONAL FOREST DOCUMENTED INVASIVE PLANTS

Scientific Name	Common Name
Brachypodium sylvaticum	Slender false brome
Bromus tectorum	cheatgrass
Centaurea biebersteinii	Spotted knapweed
Centaurea diffusa	Diffuse knapweed
Centaurea solstitialis	Yellow star-thistle
Cirsium arvense	Canada thistle
Cirsium vulgare	Bull thistle
Convolvulus arvensis	Field Bindweed
Cynoglossum officinale	houndstongue
Cytisus scoparius	Scotch broom
Elymus repens	Quackgrass
Euphorbia esula	Leafy spurge
Hypericum perforatum	St. Johnswort
Iris pseudacorus	Pale yellow iris
Kochia scoparia	Kochia
Linaria dalmatica	Dalmation toadflax
Linaria vulgaris	Butter and eggs
Onopordum acanthium	Scotch thistle
Phalaris arundinacea	Reed canarygrass
Phalaris arundinacea ssp. *picta*	Ribbongrass
Salvia aethiopis	Mediterranean sage
Salsola kali	Russian thistle
Senecio jacobaea	Tansy ragwort
Taeniatherum caput-medusae	Medusahead
Verbascum thapsis	Common mullein

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